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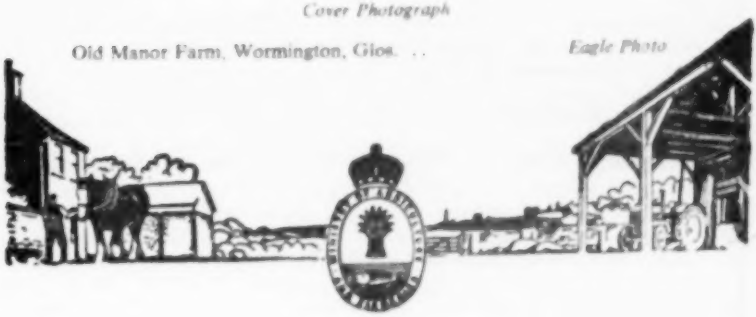
Old Manor Farm, Wormington, Glos. . . *Eagle Photo*



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MILKING BEFORE CALVING

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1. AN INVESTIGATION INTO THE NATURE OF THE SECRETION OBTAINED

THE milking of cows before calving has in some herds become almost routine practice. The chief reason is to relieve pressure or congestion in the udder, so that it may be kept in a perfectly healthy condition for its heavy task in the ensuing lactation. Premilking (or prepartum milking, as it is also called) is likely to be necessary or desirable only in those animals which have been well steamed up, for it is in these animals that udder tension is likely to be greatest. Although the relief of udder tension is the most important reason for premilking, numerous results may attend the practice, such as increased yield during the lactation, and these may well be advanced as good reasons for premilking. It may even be that these should be regarded as the true reasons for premilking, but more information is required on the subject.

The precise effects of premilking on the cow, and on its calf, may be numerous, and these can be determined ultimately only by much careful experimental work. However, some preliminary work has been done, and considerable experience has been gained by a number of farmers. Information and "milk" samples have been gathered from several herds : three Friesian, two Jersey, and one each of Ayrshire, Guernsey and Shorthorn. This investigation has yielded certain facts and opinions which are recorded below.

When an animal is milked regularly after calving, the change from colostrum* to what appears to be normal milk occurs very rapidly. This has been shown ([1],[2]) by observing the fall in globulin (non-casein protein) content. Parrish *et al.* ([2]) found 13.06 per cent non-casein protein at the first milking, and 0.74 per cent in the seventh, the latter figure being similar to that found in normal milk. Secretions obtained before calving have been analysed by certain American research workers ([3],[4]). They found that when an animal gave a fairly large quantity of liquid before calving (15 gallons or more) the liquid produced at calving was similar to normal milk according to the results of analysis. Thus it appears that some calves from premilked animals are likely to receive a liquid which is very similar to normal milk.

* Colostrum differs from milk in several respects : it is richer in globulin, vitamins and minerals.

Analysis of "Milk" Samples from Several Herds In the present investigation from four of the farms mentioned, secretions have been obtained from premilked and non-premilked animals and the health of their calves recorded. Neither prepartum feeding nor calf rearing has been standardized, the work being an investigation into farm practice rather than a planned experiment. Samples were taken as near as possible at the following milkings :

Sample	
1	When premilking first gave sufficient for analysis (½ pint) ;
2	Two days after (1) ;
3 and 4	A.M. and P.M. Samples two or three days before calving ;
5 and 6	At calving, and twelve hours after calving ;
7 and 8	A.M. and P.M. Samples one week after calving.

The following analyses were carried out :

Fat ; Total Solids ; Total Protein ; Non-Casein Protein ; Ash ; Carotene.

Non-casein protein has been called globulin in the present work. In general, it gives a good indication of the amount of globulin present ; also of anti-bodies, since the latter are associated with the globulin fraction. There is at present no direct method of determining anti-bodies in colostrum.

No separate vitamin A determinations were made, but the figures obtained for carotene were considered to give a good indication of the changes that took place, with respect to both of these constituents. The changes in the major constituents of milk just before and just after parturition were as follows :

Fat. So great was the variation within a breed that no general trend of changes was observed. Some very low values (1 per cent or less) were obtained in a few early secretions ; these, however, may have been influenced by incomplete milking.

Casein. The casein content of colostrum was between 5 and 6 per cent. whilst the milk secreted a week after calving had only about 2½ per cent. The casein content varied between samples of colostrum less than did the globulin. The fall of casein content from colostrum to normal milk was not completed at parturition for most premilked animals.

Globulin. The globulin content of colostrum from premilked animals varied considerably (20.55 to 6.79 per cent). In general, where the figure was high the total secretion obtained was small (about 1 pint), viscous, and the dry matter nearly all globulin. The variation probably depended upon the degree of stimulation given to milk production before premilking began.

The globulin content of colostrum from non-premilked animals also varied very greatly (9.24 to 4.37 per cent), the averages for these animals being considerably lower than those of the premilked animals. However, the total weight of globulin in the whole milkings showed a much closer similarity.

The nature of secretions obtained at calving from premilked animals varied according to the time for which premilking had been practised. Those animals which had been premilked longest tended to give secretions approaching normal milk at calving. The maximum globulin at calving was 11.32 per cent for an animal milked 4 days prepartum, the minimum 1.27 per cent for one premilked for 10 days. However, there was no direct correlation between the length of the period over which the animal was premilked and the globulin content. The mean globulin figures at calving for premilked animals were considerably lower than those obtained for the colostrum from the same animals, and, to a smaller degree, lower than the figure for colostrum of non-premilked animals.

There was no statistically significant difference between these results when figures for single breeds were taken ; neither was there any between the globulin contents of secretions at calving from all premilked, compared with all non-premilked animals.

There were no indications that the changes from colostrum to normal milk occurred more rapidly in one breed than another.

The study of individual results yields a greater amount of useful information than a consideration of means because the length of time of premilking varied from twelve hours to twelve days. Figures of under 2 per cent were obtained at calving from four animals, including all three breeds (Guernsey, Jersey and Friesian). Although some of the samples at calving appeared normal to the eye, none had a globulin content below 1.27 per cent. As the bulk milk contained 0.75 per cent globulin content below 1.27 per cent. As the bulk milk contained 0.75 per cent globulin, none of the samples was in fact normal. Furthermore, 12 out of 16 samples from premilked animals taken at calving had an appreciable globulin content (4.3 per cent and over).

In some cases the globulin content of milk from premilked animals taken one week after calving was rather high when compared with bulk milk.

Table 1. Globulin (per cent) in Sample from Individual Animals

Premilked							
GUERNSEY	No. of days premilked	10	3	3	1	1	1
	Globulin in colostrum	13.8	16.6	12.6	6.8	13.6	15.6
	Globulin at calving	1.3	1.6	6.8	8.3	5.8	5.8
JERSEY	No. of days premilked	12	5	4	4	3	1
	Globulin in colostrum	20.2	9.0	20.6	11.2	10.4	4.3
	Globulin at calving	4.4	2.0	11.3	5.6	6.0	4.3
FRIESIAN	No. of days premilked	6	3	3	1	–	–
	Globulin in colostrum	17.9	16.7	8.5	6.8	–	–
	Globulin at calving	1.7	8.1	7.6	7.1	–	–
Non-Premilked							
GUERNSEY	Globulin at calving	8.6	6.0	8.4	4.7	–	–
JERSEY	Globulin at calving	1.8	9.3	8.5	4.5	–	–
FRIESIAN	Globulin at calving	4.4	7.1	14.0	5.5	4.6	–

Carotene. The carotene content varied greatly between breeds, especially in the colostrum. Some Guernsey samples had a higher carotene content one week after calving than colostrum from Friesians, whether premilked or not. The general trends observed were similar to those of globulin—that is, a rapid fall occurred in samples taken after the first, but at calving the carotene content of samples from premilked animals was higher than that of normal milk.

Table 2. Carotene (mg. per litre) in Samples from Individual Animals

Premilked							
GUERNSEY	No. of days premilked	10	3	3	1	1	1
	Carotene in colostrum	17.4	17.4	8.4	4.9	11.4	6.8
	Carotene at calving	2.6	3.7	0.8	16.5	18.0	6.0
JERSEY	No. of days premilked	12	5	4	4	3	1
	Carotene in colostrum	4.4	3.6	5.7	2.4	8.7	1.9
	Carotene at calving	0.9	2.2	5.2	1.3	3.6	2.2
FRIESIAN	No. of days premilked	6	3	3	1	–	–
	Carotene in colostrum	I.S.	0.9	2.5	1.2	–	–
	Carotene at calving	1.3	1.3	2.1	0.9	–	–
Non-Premilked							
GUERNSEY	Carotene at calving	1.5	17.6	19.6	4.9	–	–
JERSEY	Carotene at calving	0.5	2.3	2.1	11.2	–	–
FRIESIAN	Carotene at calving	0.8	1.8	1.2	1.9	1.5	–

I.S. = insufficient sample

Ash. The normal fall in ash content from colostrum to normal milk tended to occur in samples from premilked and non-premilked animals, but none of the samples taken at calving from premilked animals had reached normality (0.75 per cent).

Lactose. The contents of the very thick colostral secretions obtained from premilked animals was low (1 per cent or less), rising to 4 or 5 per cent one week after calving. Although the difference is not great, premilking resulted in secretions with a higher lactose content at parturition than secretions from those animals that had not been premilked.

The term colostrum has been applied in the present discussion to the first secretion taken from an animal, whether or not it has been premilked. Colostrum from some premilked animals had very high total solids contents (over 30 per cent) and in texture were more like thin honey than the average colostrum obtained from non-premilked animals. It was not possible to obtain more than about 1 pint of this type of secretion at one milking. On the other hand, colostrum from other premilked animals was comparable to that obtained from non-premilked animals, and about 0.5 gallon was obtained at first milking. It would thus appear that if prepartum milking is commenced as soon as the udder begins to fill out, a small quantity of the viscous secretion will be obtained, whilst if it is delayed until the udder is well distended the more mobile fluid will be obtained.

The occurrence of these different types of secretions can be explained if it is assumed that the mammary glands produce two secretions. The first, a viscous fluid which has been called "globulin secretion," is produced in relatively small quantities. The second, normal milk, may be produced prepartum in pints or gallons. Hence colostrum is on this basis a globulin secretion varying with different amounts of milk, the nature of the sample depending upon the degree to which milk secretion has occurred before first milking is carried out. The weight of globulin in the different samples of colostrum from premilked and non-premilked animals was calculated, and the figures obtained were fairly similar. This shows that the above assumption is supported by the results of our analyses.

The factors most concerned with pre-calving milk secretions are :

1. The hormone balance in the animal ;
2. Udder massage and milking stimulus ;
3. Prepartum feeding or "steaming up".

The third factor is the most important so far as the farmer is concerned. If cows are steamed up to a low degree (6 lb. of concentrates per day in the last week of pregnancy), then it is probable that pre-calving milk secretion will not be great, and the milk obtained at calving will be similar to normal colostrum. On the other hand, if steaming up is on a higher level (20 lb. of concentrates per day) milk obtained at calving will be like colostrum heavily diluted with milk.

2. THE HEALTH OF THE CALF AND OTHER EFFECTS

Most discussions on premilking come to rest on the effect of premilking on the calf. This aspect of the subject has therefore received most attention in the present work. In five of the herds mentioned above, one from each breed, there were two dead calves born to premilked animals out of a total of 175 ; thus premilking did not appear to prejudice the birth of the calf.

A more serious difficulty encountered as a result of premilking is often said to be the rearing of calves born to premilked animals. A search into the experimental work carried out during the past thirty years on the nutrition

of calves shows that this is not an unreasonable suggestion. It has been found [3,6] that calves fed with colostrum during the first 24–36 hours of life suffered less from scour and had a greater chance of survival than those which received no colostrum. Though this has been fairly well established, there is as yet no general agreement on which constituent or constituents in colostrum impart these properties. The vitamins, particularly vitamin A, seem to be important [7,9] but recent work at Shinfield [8] has supported earlier experiments which indicated that certain anti-bodies associated with the globulin fraction of colostrum were responsible for the beneficial effects of this secretion. A further important point concerning colostrum feeding which had been noted at Shinfield [9] is that quite small quantities were required to prevent death ; as little as 80 ml. (about one-seventh pint) achieved this.

The susceptibility of a calf to scours and death is in some cases affected by factors other than the intake of colostrum. Williams [10] suggested that the health of the calf was affected by the diet of the cow during the last part of pregnancy. There is very little information on this subject.

Sheehy [11] has investigated another aspect of the problem—namely, the type of curd which is formed in the stomach of the calf. The occurrence of scours and death in calves was associated with the formation of a hard curd. Milk plus water gave a curd which was softer and more digestible than that from milk alone. Colostrum also produced a soft curd, the reason in this case being the high ratio of globulin to casein present. Thus the difficulty of obtaining satisfactory results from feeding ordinary milk to calves is due partly to a lack of necessary nutrients and antibodies, but partly also to the physical nature of the curd produced.

The desirability of feeding colostrum and the rapidity with which the change from colostrum to milk occurs, have led to the assumption that premilking increases the difficulties of rearing calves, since at calving ordinary milk will be produced.

The real test of the point at issue is, however, to rear or attempt to rear calves born to premilked animals. Work of this kind has been reported from America, though it is difficult to draw conclusions from it. In these experiments some calves from premilked animals were slightly more susceptible to scour and grew rather more slowly than those from non-premilked animals [12,13], while others from premilked animals [4,14,15] appeared to be normal. The latter calves received milk produced at calving plus supplementary vitamin A as cod liver oil. It was inferred, particularly by Keyes *et al.* [14] that results were unsatisfactory in calves from premilked animals unless extra vitamin A was given.

Health of the Calf The work reviewed above indicates the factors which are at present known to be important in the nutrition of young calves, but the relationship between these factors and the effect of premilking on the health of calves is not clear.

Table 3. Survey of Calves born to Premilked Animals

Herd	No. of calves	Heifer calves reared*	Number which died in first 4 weeks	Number which scoured severely
Ayrshire	13	3	0	0
Friesian	102	51	0	0
Guernsey	30	10	0	6
Jersey	20	8	0	0
Shorthorn	10	4	0	0
Total	175	76	0	0

* Only heifer calves reared.

Of the above premilked animals, samples for analysis were taken from 4 Friesians, 6 Jerseys, and 6 Guernseys.

The farms from which the samples were taken have enjoyed freedom from scour since premilking was started. They were not, however, chosen on this basis, and no knowledge concerning the calves' welfare was obtained until the investigation was concluded. No liveweight figures were available for any of the calves, but the farmers concerned in the survey were quite satisfied that there was no reduction in growth due to premilking.

Methods of calf rearing were of two types on these farms. In the first type the calf was removed at birth and fed on the dam's milk diluted with water at the rate of either 3 milk to 1 water or 4 milk to 1 water. In the second method the calf was suckled for 3 or 4 days, after which bucket feeding or nurse cow feeding was adopted.

The results of the investigation do not support the contention that premilking causes scour, unthriftiness, or death of calves. This appears to be true for all breeds.

Calves from premilked animals which received dilute colostrum or liquids which were nearly normal milk ingested much less globulin, vitamin A and carotene (no cod liver oil was given), than they would had they been born to non-premilked animals. Aschaffenburg *et al.* (9) have found, however, that 80 c.c. of the non fatty fraction of colostrum will prevent death of calves. This amount did not give normal growth, but the same experiments suggest that the globulin requirement is quite small. If 100 c.c. normal colostrum is diluted to one gallon with milk then the globulin content is about 1 per cent. Thus it may be said that, when as a result of premilking the calf receives a liquid which is like normal milk, there is likely to be sufficient of the globulin fraction to give the calf a satisfactory level of immunity. Two of the four calves born to premilked animals which gave secretions containing less than 2 per cent globulin at calving, were heifer calves and were reared without difficulty.

It may be suggested that if there is still doubt about the possibility of rearing calves without normal colostrum then some of the secretions obtained before calving may be stored in a refrigerator and fed at birth.

A second factor involved in the onset of scour and death of the calf in early life has been shown to be the hardness of the curd formed in the calf's stomach (11). Suitable softness has been obtained when milk was diluted with water. This practice has been carried out on most of the farms surveyed. It is probably an important feature in the rearing of calves from premilked animals, where the globulin to casein ratio in the diet has fallen to an extent where hard curd is likely to form.

The third factor which is important (Duncan (16)), in deciding the incidence of scours and death in calves is the existence of disease organisms. This aspect of the problem has not been dealt with in the present work, but all farmers concerned in the survey have recognized that hygiene is an important factor in preventing scour. It may be true, but there is no evidence to prove the fact, that hygiene is more important where premilking is the routine than where it is not practised.

Other Effects of Premilking *Yield in Subsequent Lactation.* Premilking may result in certain animals having a rather shortened dry period, and this it is said will result in reduced yield in the following lactation. The experience of most dairy farmers would seem to indicate that the effect of this factor is not likely to be great ; and it may be nil.

Probably a more important effect of premilking on yield occurs when secretion has been stimulated by heavy "steaming up" rations, and the animal is not milked. Just as an animal can be dried off in late lactation by leaving the udder stocked, so it is possible to partially dry off an animal before the lactation really begins [18].

Whatever may be said concerning the effect of premilking on yield, it would seem reasonable to claim that herds in which premilking is practised do not suffer from low yields.

Milk Fever. It has often been suggested that premilking increases the risk of milk fever, but this is not supported by records obtained from five herds, one of each of the breeds investigated. In 86 calvings when premilking has been practised, there were only three cases of milk fever—one each of Friesian, Jersey and Guernsey. The latter animal was known to have suffered from milk fever twice before and on neither of these occasions had it been premilked.

In America calcium and phosphorus determination have been made [17] on blood taken from premilked and non-premilked animals before and after calving. The levels of both elements fell at calving in all animals, and there appeared to be no difference in the fall in premilked compared with non-premilked animals.

Mastitis did not seem to be affected by premilking, according to the opinion of the farmers concerned. One was of the opinion that it helped to reduce losses due to mastitis, since an infection could be spotted and probably cleared up before the lactation began.

The udder is a difficult organ to manage at the beginning of a lactation, and the difficulty is sometimes increased by "steaming up". It seems that, in the opinion of the farmers with whom this problem was discussed there is a better chance of keeping the udder in good shape and condition when premilking is practised than when it is not, particularly in those animals which have been "steamed up" well.

Fertility. There was no indication in the herds investigated that premilking affected fertility in any way, though some people hold the views that premilking increases breeding difficulties.

The Length of Life of an animal may be affected by premilking, but no evidence has been encountered to this effect. In the College herd of Friesians premilking has been practised since 1945, and in some herds [18,19] for a much longer period, thus there has been time for the long-term effect to show itself should it exist.

Summary 1. The practice of premilking has been investigated on several farms. Numerous facts and opinions concerning the effect on cow and calf, have been obtained, together with milk samples from four of these farms.

2. Premilking was carried out primarily to relieve congestion in the udder, which had resulted from the preparation of an animal for the ensuing lactation by "steaming up".

3. Cows and heifers did not appear to have suffered in any way as a result of premilking.

4. Calves from premilked animals received liquids varying from colostrum to those like normal milk. Except when calves were suckled, water was

added to their diet. The importance of hygiene was observed, and with this management no difficulty was experienced in rearing calves.

5. It is concluded that premilking may be carried out without detriment to the calf or its dam.

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THE CONTROL OF BUTTERCUPS ON PERMANENT PASTURE

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A SURVEY of the grassland of Hertfordshire made between 1932–35 by R. G. Ferguson (1) revealed the various buttercups as one of the worst weed troubles ; they were particularly bad in old pastures. In sixty-five out of 488 fields for which records were made they were noted as being "in excess". The general picture in the county today seems very little different and in the old permanent pastures, where farmers often prefer not to use the plough, their control still presents a serious problem. The buttercups in these pastures consist mainly of three species, tall buttercup (*Ranunculus acris*), creeping buttercup (*R. repens*) and bulbous buttercup (*R. bulbosus*). The purpose of the present article is to describe experiments in the use of the so-called hormone weed-killers for the control of these species.

In May, 1945, after completing a series of demonstrations with the then novel chemical MCPA (2-methyl 4-chloro phenoxyacetic acid), on weeds in arable crops, a trial was started on very old grassland on the Institute farm to gain a rough idea of its probable effect on pasture buttercups and clovers. Previous attempts to kill buttercups with heavy dressings of finely powdered kainit when dew covered the grass had proved unsatisfactory, and the appearance of a new substance acting in a different manner seemed to offer possibilities for another attack on an old enemy. Two large plots were treated with 2 lb. MCPA per acre, one plot being sprayed and the other dusted, and a control strip being left between. Observations and photographic records made in June of the same year showed a complete kill of buttercups on the sprayed plot and a partial kill on the dusted plot, while on neither plot did there seem to be any serious damage to the clovers. Three years later, in 1948, the control of buttercups given by these treatments was still easily visible.

MCPA as Spray and Dust In view of the success of this trial, an experiment was begun in 1948 to compare the effects of different rates of MCPA and different times of application on the control of buttercups in pasture. The experimental layout consisted of two randomized blocks with twelve plots in each block. Three of the twelve plots were kept as controls, the remaining nine being used for applications of MCPA, at the rate of 1½ and 3 lb. per acre as dust and 2 lb. per acre as spray, applied singly on three different dates—March 10–11, April 12 and May 27. On May 21–22 counts were made of the numbers of buttercup plants on the plots treated in March and April, and the results, expressed as numbers of plants per square yard, are summarized in Table 1. It will be seen that while all three rates gave a good measure of control, a dressing at the rate of 1½ lb. per acre was inferior to the other two ; time of application seemed to make little difference. In an experiment of this sort, counts of numbers of plants, however, are rather unsatisfactory, as they give no measure of the vigour of the plants. In the present instance the plants on the control plots appeared to be much stronger than some of the treated plots, but no indication of this is given in Table 1. Again, the numbers of flowering stems produced on the treated plots were much smaller than would have been expected from the numbers of plants present. On June 16, therefore, the flowering stems were also counted, and the results obtained are included in Table 1. As will be seen from these counts, the reduction in the number of flowering stems

Table 1. Oaklands Experiment No. 1

Counts of Buttercup Plants and Flowering Stems in the same year following application of MCPA

Treatment		Buttercup plants per sq. yd.	Percentage reduction	Flowering stems per sq. yd.	Percentage reduction
	Control	51.3		24.5	
Avs. of Mar. and April applns.	1½ lb. MCPA as dust	24.3	52.7	4.8	80.4
	3 lb. MCPA as dust	17.6	65.7	1.4	94.3
	2 lb. MCPA as spray	16.0	68.8	1.6	93.5
Avs. of 3 rates	March applications	18.4	64.1	3.2	86.9
	April applications	20.4	60.2	2.0	91.8

is more impressive than the reduction in the number of plants. This effect is important, in that less seed will be produced on the treated plots and the chances of recovery of the buttercups correspondingly reduced. The buttercups were in full flower by the time of the May dressings and the tangled mass of flowering stems present after treatment made it impossible to take readings in 1948 of the effect of this application.

Further records have been made on these plots in 1950 of the effects of the dressings, including estimates of the amount of clover. The measure-

Table 2. Oaklands Experiment No. 1

Buttercup marks per plot in 1950, two years after application of MCPA

		Avs. of forms and rates			Avs. of three times of applic'n		
	Nil	March applications	April applications	May applications	1½ lb. as dust	3 lb. as dust	2 lb. as spray
Block A	95	37	26	47	60	23	27
Block B	229	127	96	101	111	128	84
Average	162	82	61	74	86	76	56
Percentage control		49.4	62.4	54.3	47.0	53.1	65.4

Reductions of over 40 per cent are significant at the 1 per cent level estimated from a logarithmic transformation of the figures (1).

ments were made by using an adaptation by the writer of the "Specific Frequency Method" for analysing pasture as described by R. G. Heddle (2). A 6-inch square frame, subdivided by strings into twenty-five smaller squares, was thrown at random twenty times in each plot. Every time that a particular species occurred in one of the smaller squares it was given one mark, irrespective of the actual quantity of it present in that square ; thus for each throw of the frame it was possible for any one species to obtain a maximum of twenty-five marks, and over the whole plot a maximum of 500

marks. Although the results obtained in this way are not strictly quantitative, they are such that the amounts of buttercup or clover present in different plots can be compared with reasonable accuracy. The numbers representing the buttercup populations are given in Table 2 and those for the clovers in Table 3.

It will be seen by comparing Tables 1 and 2 that two years after treatment the buttercups seem to have made little, if any, recovery. The controls given by 3 lb. as dust and 2 lb. as spray are highly significant, while that for 1½ lb. approaches closely to significance at the 5 per cent level. The differences between the times of application are not statistically significant, but there is a suggestion of the April dressings having given a more lasting effect. The effects on clovers can be seen from an examination of Table 3. A considerable reduction has been made in the clover population by the two higher dressings, and the damage done was less in each case with the later applications.

Table 3. Oaklands Experiment No. 1

Marks per plot for Clover Plants in 1950, two years after application of MCPA

		Avs. of forms and rates			Avs. of three times of applic'n		
	Nil	March applications	April applications	May applications	1½ lb. as dust	3 lb. as dust	2 lb. as spray
Block A	73	40	74	86	73	73	85
Block B	190	136	119	165	176	128	117
Average	132	88	96	126	124	85	101
Percentage reduction		33.4	27.3	4.6	6.1	35.6	23.5

Reductions of 33 per cent are significant at approximately the 5 per cent level.

MCPA compared with 2-4D With the increasing popularity of weed-killers containing 2-4D, the dichloro form of phenoxyacetic acid, two further experiments were begun in 1949 to compare the effect of this material with that of MCPA. They were designed also to give more precise information about the quantities of MCPA and 2-4D required and to compare the effectiveness of spray as opposed to dust dressings. Two kinds of weed-killers, one containing MCPA and one the ethyl ester of 2-4D, were applied in both spray and dust form, at rates of 1 lb. and 2 lb. per acre. With controls, the treatments necessitated ten plots, which were arranged in duplicate in the form of randomized blocks. One of the experiments was situated on a field at Oaklands on light boulder clay, where the buttercups were mostly the tall and creeping types, and the other on a field on chalky boulder clay at Buntingford with a population composed almost entirely of the bulbous species. At Oaklands the dressings were applied on April 26 and 27, 1949, before the flowering period, and at Buntingford on May 14, when the buttercups were in full flower. The bulbous buttercup flowers a little earlier than the other two species, and its flowering period is shorter and more sharply defined. When it has finished flowering the plant dies, leaving only the "bulb" just below the soil surface, a habit which makes the effect of weed-killers difficult to assess. In 1949 all treatments gave a very effective control of buttercups and, except for some of the higher liquid dressings at Buntingford, there seemed to be no damage to clovers. In 1950 readings have been made at both centres of the percentages by weight of

buttercups and clover on the plots, and summaries of these percentages are given in Tables 4 and 5 respectively. The method used in making these readings was that described by Gardner and others (4), which, although perhaps taking a little more time than some other methods of pasture analysis, has been found very satisfactory.

Table 4. MCPA and 2-4D Experiments

Percentages by weight of Buttercups in 1950, one year after application of the dressings

Treatments			Oaklands No. 2				Buntingford			
			Block A	Block B	Av.	% Control	Block A	Block B	Av.	% Control
Avs. of Rates	Dust	MCPA	1.0	0.3	0.7	82	1.6	2.0	1.8	64
		2-4D	1.2	0.4	0.8	79	2.8	3.4	3.1	38
	Spray	MCPA	0.1	0.2	0.1	96	0.5	1.8	1.2	76
		2-4D	1.1	0.6	0.9	77	1.6	1.2	1.4	72
Avs. of Forms	1 lb.	MCPA	1.0	0.2	0.6	84	0.8	2.8	1.8	64
		2-4D	1.7	0.5	1.1	71	4.0	4.0	4.0	20
	2 lb.	MCPA	0.1	0.3	0.2	94	1.3	0.9	1.1	78
		2-4D	0.7	0.6	0.6	84	0.4	0.6	0.5	90
	Nil	—	6.0	1.7	3.8	—	3.4	6.6	5.0	—

Oaklands. Sig. diff. between the averages = 2.8 at the 5 per cent level and 3.8 at the 1 per cent level.

Buntingford. Sig. diff. between the averages = 2.2 at the 5 per cent level and 3.2 at the 1 per cent level.

The results in Table 4 show the same general picture at both centres. All treatments have given some control and most of them a substantial control. MCPA was found to be superior to 2-4D, significantly so at Oaklands; sprays seemed to be consistently superior to dusts, although not significantly so at either centre; 2lb. per acre is better than 1 lb., significantly so at Buntingford but not at Oaklands. The overall control at Buntingford, though good, was not as great as that at Oaklands, but this may be due to difference in the species, to the time of application, or to other causes. However, the important conclusion to be drawn from Table 4 is that all three species of buttercup can be controlled with hormone-type weed-killers, and that those containing MCPA as the active principle are particularly effective.

Effect on Clovers The percentage of clovers at Oaklands was very small, but by grouping plots together, as in Table 5, it can be seen clearly that each form, each kind and each rate of weed-killer caused a reduction which statistical tests show was highly significant. The sprays caused a significantly larger reduction than dusts, but the differences between rates and kinds do not reach significance, although they are consistent. The Buntingford figures are very variable, and they are markedly different from those at Oaklands, in that they show little, if any, reduction in clovers for all treatments. There are several possible explanations of this difference but, in the light of Table 3, the time of application is a probable one. The apparent difference between the effects of 2-4D and MCPA is not found to be significant when tested statistically. Table 5 as a whole suggests that, from the point of view of the effect on clover, there is still some need for care in the use of this type of selective weed-killer on pasture. Taking both the

buttercup and clover results into consideration, it seems that the safest advice that can be given at present is to use no more than 1½ lb. per acre of MCPA

Table 5. MCPA and 2-4D Experiments
Percentage by weight of Clover in 1950, one year after application of the dressings

	Oaklands		Buntingford	
Averaging Rates and Kinds	Dust 1.7	Spray 0.8	Dust 5.6	Spray 6.0
Averaging Rates and Forms	MCPA 1.2	2-4D. 1.3	MCPA 4.3	2-4D. 7.2
Averaging Forms and Kinds	1 lb. 1.5	2 lb. 1.0	1 lb. 6.4	2 lb. 5.2
Nil	3.3		5.1	

or 2 lb. per acre of 2-4D and to apply this as late in the season as possible without losing the benefit of controlling the buttercups—say, when they are just coming into flower.

The Effect on Grazing While making observations at Buntingford in 1949, it was noticed that the treated plots were grazed far more closely than the controls, and that in the field generally, wherever there were buttercups, they were carefully avoided by the cattle. (The bulbous buttercup may be particularly unpalatable, as no such effect was noticed at Oaklands.) In 1950 this effect was again obvious, and it was decided to estimate the quantity of extra herbage consumed by the cattle on the plots where the buttercups had been controlled. After the field had been stocked for some months and it seemed reasonable to suppose that all the plots had had an equal chance of being grazed, the weight of herbage left on each plot was measured, using a technique also described by Gardner (4). These results are presented in Table 6. Assuming that, at the beginning of grazing,

Table 6. Buntingford Experiment. Effect of closeness of grazing. Weight of herbage ungrazed at end of approximately three months

	MCPA		2-4D		Control
	1 lb. per acre	2 lb. per acre	1 lb. per acre	2 lb. per acre	
Average weight of ungrazed herbage (*cwt. dry matter per acre*)	12.8	8.2	11.0	9.2	15.6
Difference from nil	2.8	7.4	4.6	6.4	Av. difference 5.3

there was on all the plots approximately the same amount of herbage which grew evenly throughout the grazing months, an additional weight of 5.3 cwt. of dry matter was left ungrazed on the control plots. Allowing for inedible material in the samples, this is reduced to 4.6 cwt. Presumably then, on the treated plots, this additional amount of herbage had been consumed by the cattle. If valued at only 15s. per cwt., this is worth about twice as much as the cost of applying the weed-killer.

Conclusions One fact clearly shown by these experiments is that the use of weed-killers containing MCPA and 2–4D on pasture is not such a simple matter as first appeared. The results suggest that the best time for applying the weed-killers to get the maximum control of buttercup does not coincide with that for avoiding most damage to clovers. While there is evidence in Table 3 that if these weed-killers are applied at the right stage of growth in the clover, little harm is done, until that stage of growth has been more sharply defined by further experiments, the depression recorded at Oaklands in Table 5 shows clearly that caution is needed in their use. With these qualifications in mind, the following conclusions seem justified.

1. That all three species of buttercup named in the text can be controlled by weed-killers containing MCPA and 2–4D.
2. That, except in the case of 2–4D on bulbous buttercup, and particularly when sprays are used, a good control of buttercups can be obtained with only 1½ lb. per acre of the active principle, and that on no occasion should more than 2 lb. be used.
3. That sprays seem, in general, a little more efficient than dusts and, in the case of 2–4D on bulbous buttercup, considerably more efficient.
4. That, although earlier applications probably give a better control of buttercups, for the sake of the clovers it seems better not to apply the weed-killers until the buttercups are beginning to flower.

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AGRICULTURAL VALUATION

The Committee on Agricultural Valuation appointed by the Minister of Agriculture to advise him on tenant-right matters has issued its Second Report. This discusses questions of holdover, pre-entry and term-days, and compensation provisions for several tenant-right practices. It should interest not only valuers but many landowners and farmers, particularly those who own or manage hill sheep flocks.

The Report is available from the Sales Offices of H.M. Stationery Office, or through any bookseller, price 4d. (5d. by post).

THE CONTROL OF BRACKEN ON UNPLOUGHABLE LAND

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In spite of the fact that trials of various methods of bracken eradication or control have been carried out from time to time in different parts of the country, with promising results in many cases, there appears to have been little practical follow-up by farmers and landowners in the north of England. This indicates either that the methods suggested have not been considered economic, or that the seriousness of the insidious encroachment of bracken on to useful grazing land has not been fully appreciated. Some indication of the extent of the problem in the area covered by the Yorks and Lancs N.A.A.S. Province is given in the Report of the Grassland Survey of England and Wales, issued in 1940. This shows that approximately 90,000 acres in the Province are infested with bracken. Most of this area lies in the North and West Ridings of Yorkshire, where it constitutes 4½ and 3 per cent of the total area of the respective counties. There is no evidence that the area has decreased since 1940; on the contrary, the general impression is that it is still increasing in some districts.

There is ample evidence that the increase of bracken infestation during the present century has been associated with a reduction in the number of store cattle carried on hill land and with the change-over from mainly wether to breeding flocks in the sheep population. However, where bracken is encroaching on heather land, the neglect of periodic burning of the heather has undoubtedly been a contributory factor, while in a few cases, overburning has assisted this "invasion" of the heather moor by bracken.

Whilst it is obvious that on a proportion of the infested land control would be either physically impossible or uneconomic, there is no doubt that on much of the affected areas, the degree of infestation could be appreciably reduced by the vigorous adoption of more effective control measures. Indeed, in some cases total eradication can be, and has been, achieved.

Possible Control Measures *Mechanical.* Professor K. W. Braid(1), of the West of Scotland College of Agriculture, considers that mowing with a scythe is more effective in killing bracken than the use of either mechanical mowers or bruising machines. At the present time, however, it does not appear that the greater effectiveness of hand-mowing would justify the extra cost of this method in comparison with that of the other means, especially when dealing with comparatively large areas. Braid found also that cutting machines were more effective than any type of bruising machine, and although this superiority was not apparent in the first year or two of the treatment, it was quite appreciable in the third and fourth years.

The range of conditions under which mechanical mowers will work satisfactorily is, of course, rather limited, especially on land unsuitable for ploughing, and the choice must then lie between hand cutting with the scythe or bruising with a horse-drawn or mechanically drawn implement. Two types of bruising machinery seem to be effective in killing the current year's growth of bracken. One consists of heavy square rollers which are drawn over the bracken, and another consists of a series of independently suspended

wide-rimmed wheels with cutting edges fixed at intervals across the rims. The latter type seems to have advantages on uneven land which may be full of smallish humps and hollows, as bracken land so often is.

There is a good deal of evidence that twice cutting or bruising per season is much more effective than once only ; three treatments per year is still better, but the extra effectiveness is not enough to warrant the additional cost involved. The first cutting or bruising should be done in early to mid-June (depending on the season) just before the fronds are fully open. The second treatment should be done when the new growth has reached the same stage, which will be six or seven weeks later, that is, in early August.

It is essential also to continue the twice-annual cutting or bruising for at least three or four years in order to achieve anything like complete eradication. The reduction in the amount of bracken after two years' treatment is often considerable, and the tendency is to think that it is then well under control. However, unless treatment is continued for at least another year (or, where bracken infestation was originally heavy, for another two years), the chances are that it will very soon regain its former vigour.

Chemicals. Trials conducted by Dr. W. A. Millard([2]) in Yorkshire showed that sodium chlorate applied at 1½ cwt. per acre was sufficient to kill the current year's growth of bracken and to prevent any appreciable recovery in the following two years Heavier dressings, however, seriously damaged the other herbage present (mainly grass), and left the area almost completely bare of any vegetation. Millard also tested out a proprietary hormone selective weed-killer at various rates up to 3 cwt. per acre, but found it to be totally ineffective in all cases. Braid's work in Scotland showed that the effect of using sodium chlorate was of a surprisingly long duration, and plots which were treated once with chlorate in 1937 still showed much less regrowth of bracken after ten years than plots which were cut twice in that year. Spraying with sulphuric acid kills the current growth of bracken but is no more effective than once cutting and is very much more expensive.

Use of Cattle. Crushing in spring by cattle after previous burning is a method which is extensively used in New Zealand, but the practical application of such a scheme in this country, especially in view of the risk of bracken poisoning and the present high prices of store cattle, would appear difficult. By removing cattle to better grazing for short periods every three weeks, the risk of bracken poisoning can be appreciably reduced. Recent work by Evans([3]) at Aberystwyth indicates that the administration of vitamin B_1 to affected animals reduces the death-rate from this cause.

On sheep grazings, the carrying of a certain proportion of store cattle is desirable, and New Zealand experience indicates that a sheep-cattle ratio of 6 to 1 and not more than 8 to 1 should be the aim.

Costs of Bracken Control and Value of Improvement Bracken infestation on unploughable land is confined mainly to marginal or semi-marginal land, so that the economics of control or eradication is of fundamental importance. This fact appears to have been rather overlooked in the search for the most effective method of actually killing the bracken, especially when chemical control methods have been used. In considering the economics of bracken control, the cost must of course be related to the value of the improved land. In the case of land heavily infested with bracken fern, its present value will depend on the density of the bracken cover, and in bad cases the value of the land may be negligible. Where there is any appreciable infestation it is unlikely that the present

carrying capacity of bracken land will exceed half a sheep per acre. After eradication of bracken and pasture improvement by liming, top dressing and the introduction of wild white clover, the carrying capacity of unploughable hill land which is at present bracken infested, could in many cases be raised to two sheep per acre, making bracken control, coupled with grassland improvement, a worthwhile financial investment. Even should bracken eradication result in an improvement in carrying capacity of only half a sheep per acre this would, at present prices, give a net return of £2 to £2 10s. per acre per year, making an annual expenditure of 20s. to 30s. per acre over a period of three to four years quite a profitable venture. Naturally, costs will vary considerably with conditions, but in no case should they prove excessive, always assuming that pasture improvement after the eradication or effective control of the bracken is a practical possibility.

The possibilities of using mechanical cutters on unploughable land are of course, limited, and although the cost should not exceed 10s. to £1 per acre per year, it is probable that in many cases scything at a cost of £1 to £2 per acre for twice annual cutting would be the only practicable method of cutting. Mechanical bracken crushers have greater adaptability than cutters, and the cost of twice bruising per year with a suitable machine should not exceed 15s per acre under average conditions.

Spraying with sulphuric acid or treatment with sodium chlorate would cost at least twice as much as hand cutting, and can therefore be ruled out on the grounds of expense on any but very small areas. These methods of control may possibly find a place when it is desired to prevent small patches of bracken from spreading on to adjoining grazing land.

Government assistance at present available to farmers for the control of bracken is as follows:

(*a*) A grant of 50 per cent of the cost of an approved cutting or bruising machine ;

(*b*) A grant of 50 per cent of the cost of cutting by hand ;

(*c*) The use of machines owned and operated by the Ministry at a modified charge equal to approximately half the cost per acre to the Ministry of doing the work.

Summary Despite the fact that the degree of bracken infestation on unploughable land is reputed to have increased considerably in recent years, especially since the decline in the cattle population on such land, the majority of hill farmers are not taking any effective steps either to control or eradicate the bracken. On ploughable land, bracken can be eradicated successfully by ploughing and reseeding, generally after pioneer cropping ; on unploughable land, methods which appear to give effective control are also available, but these measures must, of necessity, be coupled with pasture improvement. Accurate information as to the most effective methods of control or eradication on such land is still incomplete (e.g., crushing versus cutting), and further investigation is urgently needed into the costs of these different methods.

There would appear to be an urgent need for increased attention to be paid to the encroachment of bracken fern on useful grazing land in many parts of the country and for a stimulation in advisory work on the most effective control measures.

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HIGH PRODUCTION ON SECOND-RATE LAND

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FROM a smallholding of 20 acres in 1927 to the intensive farming today of eight farms comprising 1,237 acres is the achievement of Mr. J. P. Morris, of South Duffield, East Yorkshire. The crops include 100 acres of potatoes, 150 acres of peas for pulling green, 60 acres of carrots, 60 acres of sugar beet, 20 acres of cabbage, 62 acres of mangolds, swedes and kale, 160 acres of wheat, 105 acres of barley, oats and rye, and 100 acres of one-year seeds. Stock consists of about 100 cows, 200 other cattle, and 800 poultry. But this is not the whole story. Most of the land was second rate when taken over, much of it wet, much of it extremely short of lime, some of it desperately poor and some out of cultivation. Of this land, 205 acres have been tile drained, and 21 acres have been mole drained. Lime has been used in large quantities to correct the soil acidity, 781 tons of carbonate of lime being used last year, for instance, and 950 tons the year before ; now the need for lime is decreasing. Fifty-six acres have been reclaimed from scrub or moorland and reclamation of this type is still proceeding.

The soil on the farms varies from sand so light that it will blow in a high wind, to heavy land of a lacustrine clay type. The staff consists of about 30 regular workers, and a good deal of casual labour is employed. The annual wage bill is about £15,000.

The Importance of Peas Mr. Morris considers peas for pulling green to be one of his best investments, and they have always been a very important crop in his farming. In addition, they have a relatively short growing period and leave the land in a good state for the next crop, which is normally wheat, a grain that the country needs as a dollar-saver. Green peas are, however, a highly perishable crop, and it is important to have a good market connection to dispose of them and an adequate labour supply to pick them as required. In his earlier farming days Mr. Morris grew peas on light sandy soils, but now a substantial acreage is grown on good-bodied land. A farm of this type recently taken over, once wet but since drained, has proved to be very valuable for peas, particularly for the later-sown varieties.

Peas are sown from the end of March to June 20, so that their picking is spread over a wide season. Normally, all the peas sown up to June 8 are reasonably safe for pulling green, but sown after that date they are a gamble. They can, on occasion, do very well when the weather conditions are right, but a wet season is fatal. In addition, an opportunity is afforded for bastard fallowing the land before the late peas are sown. All the early peas are grown on the sand, but their area is restricted to about 20 acres. Mr. Morris considers that he cannot compete with the south for earlies and that main crops and lates are preferable.

The manuring is generous, up to 8 cwt. per acre of potassic superphosphate, and lime where necessary. The varieties used for the earlier sowings from mid-March to mid-April are Thomas Laxton and the shorter-strawed Laxton's Progress and, for sowing after mid-April, the variety Onward. The seeding is 12 stone per acre for earlies, 10 stone per acre for May, and 8 stone per acre for June sowings.

The peas are grown in 19-inch rows. This may be considered to be rather wide, but there are three reasons for choosing this width. First, it avoids alterations to the tool-bar for rowcrop work, as all the root crops—sugar beet, carrots and even swedes and mangolds—are grown in 19-inch rows. The only exception to this rule is potatoes, with 28-inch rows. The second reason is to allow for row scruffling. Peas encourage weeds, and with such a large acreage, particularly on the sandy land where every weed seed seems to grow, a strict control of "rubbish" is essential. With close scruffling to 1 inch at each side of the peas, 15 or 16 inches of soil are cleaned in every row. The third reason is that peas with plenty of room seem to yield as well if not better than those sown in narrower rows, and the pods are often better and bigger, making a bolder sample. A normal crop is about 180 bags of 40 lb. each per acre. Yields up to 300 bags are obtained occasionally.

The importance of having a good outlet or market for this highly perishable crop has already been referred to. As a young man, Mr. Morris had an intimate experience of marketing, for he relied for his living on the buying and selling of peas, potatoes and carrots and speculating with farmers in growing peas. He maintains that there is a marvellous home market for produce when the buyer can rely upon every consignment being well grown, well packed and received fresh. The peas are all pulled into baskets, and as they are brought and tipped into the weigher, every pod passes in front of the weighman's eyes. With baskets, too, an opportunity for sitting on the peas does not arise—an offence that may occur when they are picked directly into sacks, particularly by young pickers at the end of a hot day when the bags get heavy.

Some of the pea haulm straight from the pickers was dried last year for the first time in a newly-installed grass drier. The haulm at this stage, green and immature, produced a dried food, green in colour with a good smell, that was highly relished by stock and seemed to give good results. It is intended this year to dry all the pea haulm.

Carrots and Potatoes Carrots, another important crop, are confined to the light sandy soil and are generally taken after potatoes. About 10 cwt. per acre of No. 1 National Fertilizer are applied. The seed is never sown before May 20 on account of the carrot fly. It has been found from experience that the risk of damage from this pest is much reduced if sowing is delayed until this date, and mid-June is found not to be too late. In fact, very good crops have been obtained from June sowings, and the quality is often better than with May 20 sowings. Mr. Morris is convinced that quality will count more now that the practice of washing carrots before selling has returned, and it will pay to produce a blemish-free sample.

The weeds are controlled by spraying with light mineral oil, and hand weeding is reduced to a very small item. Spraying has been done at all stages of the carrot's growth, but the best results have been obtained when the plants had only two or three leaves and the weeds were young. The oil, it has been noticed, also helps to clear the greenfly, which in some seasons can do a great deal of damage to seedling carrots.

On the light sandy soil farmyard manure is regarded as essential for potatoes, not only for its manurial value but also as a soil conditioner. To save precious time in the spring, the manure is applied during the previous autumn and winter. The aim is 20 tons per acre, and for its production all the available buildings are filled with cattle. About 200 tons of straw are bought in summer, when it is cheap and there is some choice, to supplement the home-produced straw. Some dung goes also on mangolds and sugar beet.

When dung is used liberally, the potatoes appear to be less affected by a dry season than where fertilizers only are used. Last year (1949)—a phenonomenally dry year—the potatoes did exceptionally well. On the heavier land, too, dung is used and found beneficial both for the crop and the structure of the soil. Clover stubble is regarded as a good place for potatoes, and last year one field after clover, fresh to potatoes, yielded 14 tons of Arran Peak per acre. In addition to the farmyard manure, varying quantities of No. 1 National Fertilizer are used : 14–15 cwt. for Majestic, Arran Peak and Gladstone down to 10 cwt. from Arran Banner. Planting begins in mid-March and is usually completed within a month. The bulk of the seed is new Scotch or Irish. No early potatoes are grown, since their lifting would interfere with the pea picking, which goes on from July to the first week in September.

Cereals after Peas Of the 265 acres of cereals, 160 acres are under wheat. It is a very suitable crop after peas. On land too light to suit wheat, rye is grown instead (about 45 acres last year). Barley hardly comes into the picture ; last year there were only 10 acres. The remainder of the cereal acreage, about 50 acres, is oats, grown for feeding to the cows and other stock. All the cereals are sown with a combine drill and all receive some help with artificials.

No strict rotation of crops is adopted, but certain principles are kept in mind. Potatoes are never grown more often than once in five years, as potato root eelworm is a serious trouble in this area. Every year the aim is to have 150 acres of peas for pulling green. These are followed by wheat, where the land is not too light. After wheat there may be a diversity of crops—sugar beet or potatoes or winter oats S.147. Carrots may be grown two years in succession to make up the acreage, if other suitable land is not available.

With so many crops involving heavy labour demands, the spreading of the labour, both permanent and casual, throughout the season is an important factor in arranging the cropping programme. Peas for picking green are spread over a wide season, both as regards sowing and picking. Spring corn goes in as early as the season permits, potatoes follow in March and April, then sugar beet and mangolds, and there is a breathing space before a start is made on carrots. In the back-end wheat goes in early on the pea land. Potato lifting follows, then mangolds, then sugar beet, and if necessary the latter can be left in the light dry land until Christmas.

The Land Improved Much of the grassland has been reseeded, some direct but mainly after taking a few crops. Some of the original grassland on the farms is now arable. All of it is limed at intervals with 1 ton carbonate of lime per acre and has each year recently been receiving 5 cwt. of No. 1 National Fertilizer, the aim being more and better grass to carry more stock with less feedingstuffs. Some of the grassland now fattens over one bullock to the acre without the use of concentrates.

At one farm there is a dairy herd of Ayrshire × Shorthorn cows being graded to Ayrshire. On the other farms the cows are sired by a beef bull and used for suckling calves only. Originally a Lincoln Red bull was tried but now Hereford bulls are used. Each cow rears five or six calves. The cattle are wintered in strawyards and those fed for beef go off the grass fat at about 2½ years old.

An interesting and valuable experience was gained during the war when, under a Ministry experimental scheme, 60 acres of blowing sand were

marled*. The marl, a limy clay, lay below the fields to be marled, covered by an overburden of 3 or 4 feet of sand. About 160 tons of marl per acre were applied, more to the lightest sand and less where it was not quite so light. The most important benefit obtained was that the marling stopped the blowing of the sand. Before the marling, crops, seed and often fertilizers were repeatedly blown out of this land and ditches were filled with sand. Of still greater consequence was the loss of time, the resown crop often being too late to do well. The first crop after marling was carrots and they did quite well. The next crop was peas, which yielded three hundred 40-lb. bags per acre—an exceptionally high yield.

With farming of this type good marketing is most important, and to ensure a good market Mr. Morris contends that the most important thing is to produce a good article. He built up a connection in the bad years by sending to the towns really high-grade produce, so that from the start he never had a complaint. It might have been thought that by taking out a good deal to up grade a sample, one would lose by it. But this is not so ; for in the long run he has never been short of an order.

DITCHING AND DRAINING

R. B. Dottridge

Land Drainage and Water Supplies Officer,
Surrey Agricultural Executive Committee

THE following hints on ditching and draining, although elementary, are sometimes overlooked. They may serve as a timely reminder to those engaged on these useful activities during the coming months. In dealing with an old neglected ditch, where there is a lot of muck to come out, it is a bad practice to try to pack it all into the hedge ; some of it is bound to fall back again. A certain amount can be put in the hedge, but the remainder should be spread well out over the field. It should not be put on the edge of the ditch on the open side, for if the field slopes towards the ditch the surface water will be prevented from draining into the ditch, and moreover a lot of weed seeds will germinate on the spoil bank. In this position they will have to be eradicated by hand control, whereas out in the field they can be controlled by normal field cultivation.

The shape of a ditch is of importance if future maintenance costs are to be reduced to a minimum. An easy formula to remember for this is : *bottom width plus depth should equal top width.* There are several reasons for this shape, the most important being that less soil falls from the sides through weather action (i.e., sun, rain, frost, etc.) than where the sides are vertical. There is, therefore, less dirt to dig out to maintain the ditch in good shape. The narrower bottom tends also to give a self-cleansing effect, and with the wider top there is a better chance for, say, a twig which may become wedged across the ditch to rise and straighten itself with any rise in the water level in the ditch. Where any crossings in ditches are called for, the pipes must be big enough to take "storm water", and to prevent blockages from twigs and leaves, they must never be less than 9 inches in diameter. Blockages of this nature ruin a ditch and if left for long can cause a lot of work in restoring

*Clay marling experiments in the East Riding of Yorkshire during 1944-46 were described by R. B. Ferro and A. C. Middleton in *Agriculture*, 1949, **56**, 123-8.

the ditch to its former condition. It is as well to remember, when digging ditches, that most fields have been tile drained at some time in their history, and very often these old systems are able to function again if the ditch is dug to its original depth. Unfortunately there is no uniformity about the depth of old tile systems but it is fairly safe to assume a minimum depth of 2½ feet. In any event it is always as well to keep underdrainage in mind when ditching ; for most underdrainage systems an outlet ditch of a minimum depth of 2½ feet (where practicable) is necessary.

Finally, ditches must not be left to the mercy of treading by cattle, otherwise the time and money spent on digging them out will be wasted. Protective fencing can be erected quite cheaply. If a ditch is properly constructed and protected, the cost of maintenance, provided it is done every year, will be negligible.

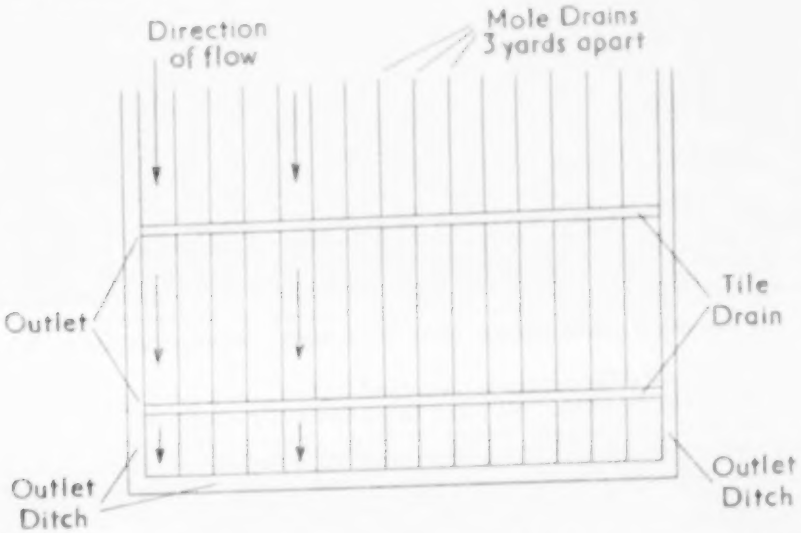
Underdrainage Underdrainage is usually carried out for one of three reasons: to lower the water-table; to intercept springs; or to encourage a freer percolation of surface water, which, in other words, is the drainage of heavy land. Taking the last first, I think the most economical way of dealing with this is by a combination of the use of the mole plough and tile drains. The distance between the drains should be adjusted to match the weakness in the clay. For example if the subsoil is a good stiff clay, the tile drains could be 400 or 500 feet apart, but if the clay has stones in it or a wash from another strata such as sand, chalk, etc., the distance should be reduced according to the extent of the adulteration of the clay—say, to a minimum of 100 feet. The danger of this method lies in the possibility of misjudging the distance apart for the drains; if an error is made in this respect, localized wet spots will occur where the moles "blow". Incidentally, a tile drain should be laid above all ridges and any depressions across which the beam of the mole plough could not "ride" without altering the depth of the sub-channel being formed.

The advantages of the method just outlined do not lie only in the saving in cost. The passage of the mole plough through the ground breaks any pans which may have formed, and the fissures made give aeration, a vital part of heavy land management. It is often found that after a number of years a pan forms over tile drains, rendering them less effective. Subsoiling is, therefore, recommended as a necessary part of the cultivation of that land. If in land where mole drainage is practical the moles are drawn across the tile drains every four or five years, not only will efficient drainage be achieved but efficient aeration also.

The tile drains over which the moles are drawn should be covered with a porous material, graded clinker for preference, the moles discharging into this. The layout of the drains depends entirely on the contour of the land, but, as a general rule, orthodox tile drainage systems with leaders and laterals can be adopted. Fields sloping one way can be dealt with by putting a drain at the bottom of the slope, remembering that the machinery requires about 11 yards for turning and that the plough must not be pulled out until it has crossed the drain or, vice versa, pulled in before it crosses the drain. If further drains are required because the distance for the moles would be too great, they can be added up the slope at the necessary distance apart, running parallel with the first drain and cutting across the slope (see diagram).

Drainage problems caused through too high a water-table are usually found in pervious soils at a low elevation, where moles are useless. Very often, however, an iron pan forms in this class of land ; deep subsoiling is useful to break this up, and the mole plough can be used for this purpose.

The only way in which this class of land can be drained (other than by open ditches, which, of course, are the most effective means but which would make future management of the land suitable only for market gardening) is by tile drainage. This can be less intensive than would be necessary to drain heavy land thoroughly by this means alone. On heavy land there is no lateral movement of water in the soil, and thus the drains would have to be very close together, whereas with these lighter soils there is lateral movement and the drains can be spaced fairly wide apart, say two chains. Therefore, the cost for tile drainage of the lighter soils is not prohibitive. The drains should be as deep as the outlet will permit and the tiles must be laid on a firm bottom.



In dealing with springs the most important thing is to ensure that the intercepting drain is above the "spring line" and is as deep as possible. An estimate should be made of the volume of water to be trapped so that an adequate sized pipe is used.

I am frequently asked at what gradient pipes should be laid. As it is seldom possible for level sections to be made, I do not think it is necessary to be too rigid about this. The natural fall of the land should be utilized, except where it is necessary to win depth, when a fall just sufficient for water to run should be dug.

★ *A Tribute to the Land Girls*

The Women's Land Army will be disbanded on 30th November, 1950, after eleven years' splendid service. The occasion will be marked by a specially contributed article in the December issue of *Agriculture*, by Mrs. Inez Jenkins, C.B.E., who was Chief Administrative Officer of the W.L.A. from 1945 until 1948.

RABBIT DAMAGE TO WINTER CORN

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ALTHOUGH the rabbit is recognized as a serious pest of agricultural crops, the extent of the damage it does to winter cereals is not widely known. As a result of a survey carried out in 1949–50, we estimate that in East Anglia at least £100,000 worth of winter corn was lost during the season through the grazing of rabbits. The damage consists of a more or less clean cut at right angles to the blade of the leaf of the young plant, and the whole field, or a large proportion of it, is more or less uniformly affected, so that from a distance it appears to be bare. Attacks usually occur in fields near woods or rough country and are reported from December to April on all types of winter corn. Occasionally areas of as much as 50–60 acres are denuded. Sometimes rabbits show a preference for a particular field or a particular crop or variety, but as soon as this is exhausted they usually turn their attention to whatever is available.

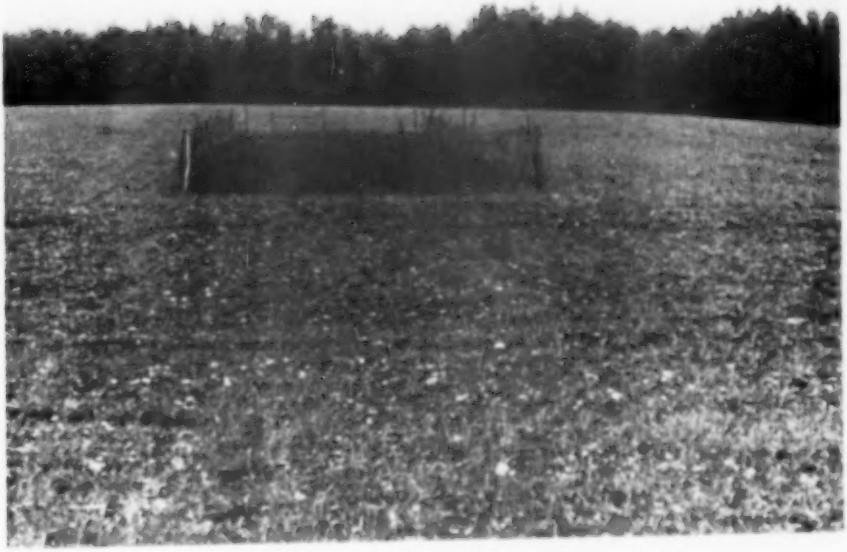
Characteristic Damage Some farmers are familiar with this damage and experienced advisory officers also recognize the rabbit as the cause. Nevertheless the extent of the grazing in 1949–50 and the scepticism with which many farmers received our diagnosis, prompted us to try to provide definite evidence that the rabbit was responsible. Since there is apparently no published account of this type of damage, apart from the paper by Roebuck, Baker and White [1] on grazing by the wood-mouse, we thought it worth while to place our observations and conclusions on record.

The nature of the damage at once shows it to be caused by the grazing of a herbivorous mammal. All other agents are easily eliminated from consideration ; for example, attacks by slugs, cutworms and leather jackets produce very different symptoms, and to cause damage on a comparable scale they would have to be present in such numbers as to be quite obvious. Nor can this characteristic damage be ascribed to birds ; although birds might reproduce it on individual plants, they never feed regularly and systematically over a field and, moreover, they commonly pull up plants and leave odd sections of leaf on the ground.

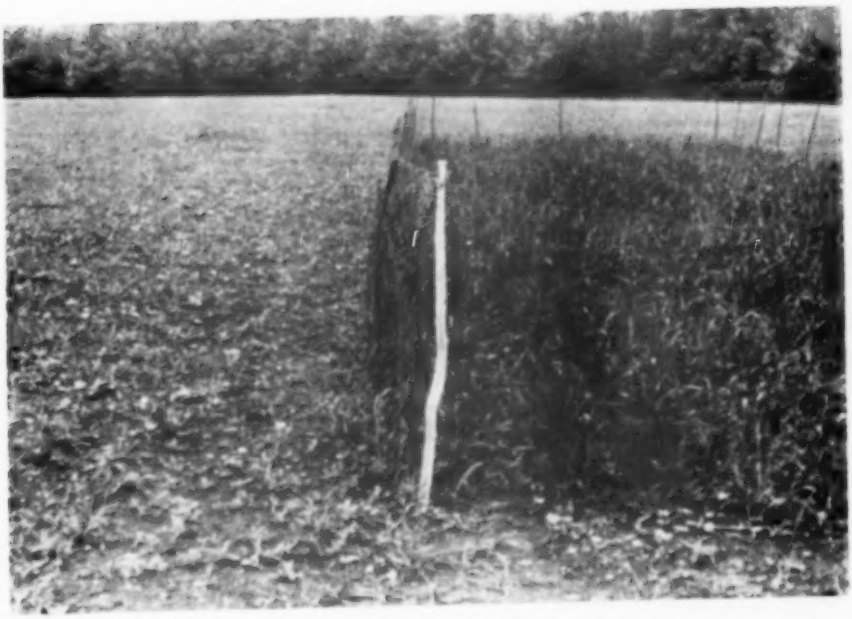
We were therefore faced with the same problem as Roebuck and his colleagues to decide which of the mammals was responsible. Under their conditions they gave reasons for implicating the wood-mouse. We failed to find evidence that this mouse was concerned in the fields we studied, and all the evidence, both circumstantial and direct, points to the rabbit. It is often stated that rabbits tend to feed in irregularly distributed patches, and we agree with this view when the amount of available food is large in proportion to the number of rabbits, as in early summer ; but when food is scarce, growth of plants slow, and rabbits numerous, it seems inevitable that individual feeding areas will merge.

The extent of the areas affected and the fact that grazing commonly proceeded ¼ mile, and occasionally ½ mile, from the woodside where it commenced, also make it improbable that the smaller mammals are concerned. The greatest distance from a wood at which wood-mouse grazing is recorded is 165 yards[1].

Farmers have sometimes commented on the relatively slight traces of rabbits in certain fields, but it is difficult on the basis of present knowledge



Plot wired against rabbit damage February 18; photographed May 7



Same plot photographed May 7

Oaklands Experiment No. 1. Plot on right of handkerchief has received 2 lb. MCPA per acre as spray in April, 1948. Plot on left of handkerchief is a control. Photographed June, 1948.

Photo: H. R. Gaskins

Oaklands Experiment No. 1. Same view as above taken a year later (1949) without further dressings.

Oaklands Experiment No. 2. Left of line 1–3 is the untreated pasture. Plot on right of line 1–3 has received 2 lb. MCPA per acre as dust. Plot behind the line 3–4 has received 1 lb. MCPA per acre as dust. Dressings applied and photograph taken in 1949.

Buntingford Experiment. The plots on the front left and rear right sides are controls. The plot on the front right has received 1 lb. 2, 4D per acre as spray and that on the rear left 2 lb. 2, 4D per acre as spray. In the background is the untreated field. Dressings applied and photograph taken in 1949.

Photo: Farmers Weekly

Wired plot on left, unwired plot of equal size on right. Photograph taken September 1

Wheat plants, grazed and ungrazed by rabbits. Note lack of secondary roots and tillers

to assume a direct connection between, say, numbers of droppings or runs and numbers of rabbits feeding. Southern [2] states that faecal pellet counts are of no use as indicators of total population, owing to the uneven population distribution and the fact that "lavatories" are used.

It is also necessary to draw attention to the very small amount of food on a given area of corn during the early winter. Although precise figures are needed, it is clear that a small number of rabbits can quickly eat off an acre at that time of year. With such extensive foraging areas, it also seems reasonable to assume that the rabbits are less likely to form well-defined tracks. Such points, however, require much more intensive investigation.

These, then, are the general arguments which led us to consider that the rabbit was primarily responsible for the extensive grazing of winter corn. More direct proof has taken two forms. Firstly, grazed fields have been visited at night and driven over systematically with headlights. In all fields rabbits were numerous and on certain occasions the following counts were taken :

Field 1. 11.30 p.m. February 21, 1950. Frosty night after wet period. About 20 rabbits seen on small part of 16 acres of wheat.

Field 2. 11 p.m. March 7, 1950. 21 rabbits seen on 1¼ acres of wheat adjoining one end of Field 3.

Field 3. 11 p.m. March 8, 1950. About 100 rabbits, mainly in pairs, seen on 54 acres of wheat.

Field 4. 10.45 p.m. April 3, 1950. About 60 rabbits, mainly in pairs, seen on 36 acres of winter oats.

Even by day, if a careful approach were made, many rabbits were to be seen feeding, and small numbers were often put up from surrounding hedges and ditches.

Secondly, in Field A, which was under constant observation, small plots were enclosed with 1½ inch mesh netting, 3 feet in height and, although these cages were not erected till late in the season, the corn inside them grew away rapidly in sharp contrast to that outside which continued to be grazed right up to the wire. Birds and smaller mammals had free access to these cages. In districts where this typical grazing was common, damage did not occur on fields which were adequately rabbit-proofed, and substantial improvements were also noted where netting was erected after the damage had begun.

Mr. H. C. F. Newton, advisory entomologist W. Midland Province, tells us that he has also made similar observations and drawn the same conclusions.

The Effects of Rabbit Grazing In previous years the majority of grazed crops have eventually grown away, except perhaps when insect pest attacks have followed, though the ultimate effect on yield remains unknown. In 1949–50, however, not only was the grazing more widespread and on a much greater scale, but the effects were exceptional and failures were common. There are several reasons for this :

1. Mild winters during the previous three years had allowed breeding to continue practically throughout the year, and at the beginning of 1950 the rabbit population was higher than it had been for a long time. It has also been suggested that the cessation of open trapping has been a contributory factor.

2. The dry summer and autumn of 1949 and the consequent poor growth of grass and other greenstuff reduced the amount of food normally available to rabbits in late autumn and early winter.

3. Owing to the very dry weather up to mid-October and prolonged rain for the next two or three weeks, sowings were often delayed or took place under rather unfavourable conditions.

The combination of poor plant growth with attack early in the season by hungry rabbits was frequently disastrous. Plants failed to make any growth and, as will be shown later, were often killed. A feature of such plants was their failure or delay in putting out secondary roots and tillers.

By March many grazed wheat fields exhibited such complete failures that on first inspection it was impossible to determine the primary cause. Gradually, however, the various other possibilities of insect pests, diseases and soil deficiencies were eliminated, and the only common factors remaining were rabbit grazing and, not infrequently, poor consolidation. It became necessary, therefore, to discover whether rabbits, lack of consolidation or some other cause was the primary factor. The evidence leading to the conclusion that rabbits were responsible was obtained in a number of fields in Hertfordshire where grazing had proceeded over a long field so that part had been grazed early and persistently, and the remainder had either not been grazed or the corn had the chance to establish itself before being attacked. Differences between the different parts of these fields could therefore be reasonably attributed to the effect of grazing alone.

Plant counts (twenty 2 feet squares taken at random) were made in early April on each section of these fields and sample plants were also examined for tiller formation and the presence of secondary roots. The history of each field was followed carefully up to harvest time. Limitation of space does not permit a full account of all these fields, but one is described in some detail as it is typical of many. Full details and figures for the other fields are available on request.

Field A

This is a 16-acre field, about 450 yards long, bounded on the north side by wood and scrub heavily infested with rabbits. Bersee wheat was combine drilled with 3 cwt. compound fertilizer at the beginning of November at a seed rate of 2½ bushels per acre. It came up well, and by early December the field was green over. By December 12, about 6 acres, extending about 150 yards, from the wood, was grazed bare. By January 20 a further 6 acres had been grazed, and by January 30 the grazing had reached within 70 yards of the southern boundary. At this stage the field could be divided into three sections : (1) the northern or woodside 8 acres, which were grazed practically to the ground and on which the rows were indistinguishable ; (2) the middle 5 acres, which also appeared bare at a distance but where the rows could just be made out on close inspection ; (3) the southern 3 acres, which was thick and vigorous, though some insignificant grazing had taken place.

A general improvement, most marked in the middle section, occurred after a wet spell in February. The woodside 8 acres, however, remained bare though the plants had made some growth and in places the rows were visible. On February 18 a 1½ inch mesh wire-netting cage, 17 × 4 yards in area was erected here. A marked difference appeared in this cage within a few weeks. By March 16 at a distance it appeared as a green patch, and by April 8 the plants were about 6 inches high, whereas outside the cage the corn was still being grazed right up to the wire. On April 16 the northern part of the field was redrilled with barley, though for purposes of comparison an area of 10 yards all around the cage was left in wheat. Even the barley was unable to keep pace with the grazing, and 1 or 2 acres near the woodside failed completely, except where protected by netting. By July 27 the southern half of the field and the wheat in the cage had turned colour, whereas the remaining wheat in the northern section was still green, and the harvesting date here was 18 days later. The wheat from the cage and an adjacent area of equal size was cut and threshed separately by stationary combine, and the yields corresponded to 8½ quarters per acre in the cage and 2¼ quarters per acre outside it. These yields refer to undressed corn but are corrected to 15 per cent moisture content.

The plant counts and estimated yield at harvest time for the grazed and

ungrazed areas for this and three fields of winter oats are given in the table below :

Average Number of Plants per 2 ft. square and Estimated Yield (qr. per acre)

	Not grazed or lightly grazed area	*Heavily grazed area*	% loss of plants
Field A. (Wheat)	71.5 (8 qr.)	27.3* (failure)	62
Field B. (Oats)	61.1 (6 qr.)	11.7 (failure)	81
Field C. (Oats)	67.7 (7–8 qr.)	30.4 (3–4 qr.)	55
Field D. (Oats)	83.0 (5 qr.)	43.0 (2 qr.)	48

All the differences in plant counts are statistically significant.

* The figures for the central moderately grazed area were 63.9 and 44 qr.

The striking feature shown by all these figures, and borne out by observation on many other fields, is that the plant population is reduced by 48–81 per cent on the heavily grazed areas.

Although the shoot counts per plant were usually lower on the grazed areas, the differences were rarely statistically significant, but an earlier examination would almost certainly have revealed greater differences. The same remark applies to the formation of secondary roots, and suppression of these was consistently noted in wheat samples taken in late March from heavily grazed fields.

Another point which should be emphasized is that wherever the crop was thin, the bare spaces soon filled up with weeds.

Damage in East Anglia County and district advisory officers of the N.A.A.S. Eastern Province† have kindly provided approximate acreages of fields actually reported to them, or known by them, to have been grazed, and also the acreage which either failed or was likely to yield very poor crops because of grazing. The figures ranged from practically nothing in the fenland counties of the Isle of Ely and Holland (Lincs.) to over 6,000 acres grazed in Norfolk, and over 1,000 acres failed in both Herts and Essex.

A total of 16,900 acres of winter corn in the province was known to have been grazed and a total of 3,700 acres either failed or was likely to yield only a very poor crop. These known figures probably represent less than half the total acreage affected. It is worth noting that East Anglia is not regarded as being heavily infested with rabbits, compared with the western areas of England and Wales. Other parts of the country have not been surveyed in detail as far as we know, but the grazing of winter cereals by rabbits has been recognized in other provinces for several years.

Intensive Survey of Part of Hertfordshire It was thought that a detailed field to field survey of a small area would be a useful supplement to the general picture and at first a circle of 1¼ miles radius from Field A was chosen as a heavily infested district. It was also thought that a larger area would give a more representative picture, and accordingly 21 square miles north of Hertford were surveyed. The final figures proved to be very similar for both areas, though it would be incorrect to regard them as typical for the whole of Hertfordshire. Nevertheless this is a well-wooded county and in certain districts rabbits are numerous.

Nearly every field of winter corn within the areas was seen during the winter or spring and again at or near harvest time, and the impressions thus gained were supplemented by discussion with the farmer.

† Comprising Beds, Cambs, Essex, Isle of Ely, Herts, Holland (Lincs.), Hunts, Norfolk, East and West Suffolk.

The results are set out in the following table :

	Small Area	*Large Area*
Total Acreage	3,170	13,156
Acreage of woodland and scrub	582	1,834
Acreage of winter corn	593	1,969
Acreage of winter corn which failed or was only half crop	184 (31%)	533 (27%)
Acreage of winter wheat	380	1,341
" " wheat which failed	76 (20%)	231 (17%)
" " wheat only half crop	56 (15%)	145 (11%)
" " oats	196	599
" " oats which failed	22 (11%)	89 (15%)
" " oats only half crop	30 (15%)	61 (10%)

Thus even in the larger area, 27 per cent of the winter corn either failed or only yielded half a crop because of rabbit grazing. If we translate these acreage figures into monetary values it appears that in the 21 square miles about £8,000 worth of wheat has been lost. This can be offset to some extent by the value of spring barley where fields which failed were resown to this crop. It is less easy to calculate the financial loss of the oats to the farmer but on the current price of about £1 per cwt., the loss represents £2,000.

Conclusions It is not the purpose of this article to discuss methods of controlling rabbits. Such measures are well known, though not always easy to carry out. As a palliative measure, however, it is worth while considering the erection of temporary netting across the ends of a field adjoining rabbit-infested land and continued along the sides of the field for some distance. Such wire need not be buried and, although it is not completely rabbit-proof, it may reduce grazing considerably.

Finally we emphasize the main points.

1. Rabbits commonly graze large areas of corn during the winter so that whole fields appear bare and remain so during the winter months. Farmers experiencing this grazing damage are often of the opinion that rabbits are very scarce or even absent on their land, but it must be remembered that severe damage can be caused by a relatively small number of rabbits, and that rabbits will certainly travel as far as ½ mile to graze crops and probably sometimes go even farther.
2. If the damage is persistent the plant population may be reduced by as much as eighty per cent, so that complete failures or reduced crops may result. Even much smaller reductions may weaken the crop so much that it cannot withstand subsequent attack by insect pests. Also, ripening of a seriously grazed crop may be delayed by 10–18 days.

We acknowledge gratefully the willing co-operation of many colleagues in various sections of the Advisory services. We would also like to record our appreciation of the information and facilities for observations provided by numerous farmers. Lastly, we are indebted to friends for helpful criticism of the paper in draft.

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THE WINTERING OF WELSH MOUNTAIN EWE LAMBS

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HILL FARMERS have to make special provision each winter for the feeding of the annual crop of ewe lambs. The traditional method is that of moving the ewe lambs to lowland farms, but a few hill farmers, alarmed by the rising costs of the past few years, are endeavouring to winter some at least of their lambs at home ; in some cases suitable land may be ploughed and reseeded specifically for this purpose, while in other cases any lowland grazing attached to the hill farm may be pressed into service. However, on many hill farms, the alternative methods are not possible. Briefly, then, lambs born in April spend the summer months with their mothers and then in October or November are sent to lowland farms. During March or April, depending on local custom, they return to the hill.

That such a procedure should have to be adopted is at once a reflection of the difficult conditions characteristic of many hill farms during the winter months. Indeed it can be said that the main problem of the hill farmer is to bring his flock safely through the bottleneck of winter, a period when the sheep have to exist on a semi-starvation diet. On good lowland farms the ewe lambs are given sufficient grazing to enable normal growth to proceed, and the flockmaster is usually spared any anxiety on their account.

The special attention given to wintering illustrates the importance attached to adequate nutrition during the early stages of growth. It is most essential that a hill ewe, which, prior to drafting out, will have reared three or four lambs under difficult conditions, should at least face the task adequately developed. A satisfactory nutritional level during the first winter seeks to ensure this.

Most hill farmers agree that ewe lambs should complete their first winter in a hard thriving condition. Some believe that it is possible to do them too well, with the result that they lose condition appreciably when turned on to the hill. Indeed practical men would rather see their sheep return a little on the lean side rather than carrying too much flesh. Some hill men believe that certain localities are better for their sheep than others, and there are certain farms in all localities which are keenly sought for wintering purposes. Once satisfied, a farmer endeavours to retain a good centre, and may send his sheep to a particular farm for many years.

Utah Experimental Station Work Although wintering is regarded as sound hill sheep farming husbandry, experimental evidence relating to its benefits is scanty, and the major contribution has been made by American workers of the Utah Experimental Station (1), and an attempt will be made here to summarize this work. It should at once be made clear that the conditions under which the American investigation was carried out differ considerably from those in this country. Nevertheless, it is felt that the findings have a significance for hill farmers in Britain.

Under range conditions in Utah the age for breeding is 18 months, and a common experience was that some of the sheep were undersized, which had adverse repercussions on the lamb crop. This state of affairs arises from the failure to provide the ewe lambs with sufficient good grazing during their

first winter. In the experiment four groups of lambs were taken after weaning and given the following treatments :

Group I (25 sheep) fed alfalfa (lucerne) hay, with access to bone meal and salt.

Group II (25 sheep) fed alfalfa hay and barley meal, with access to bone meal and salt.

Group III (25 sheep) fed alfalfa hay and maize silage, with access to bone meal and salt.

Group IV (50 sheep—the control group) placed in a range flock and handled in a similar manner to other range sheep.

Groups I to III were fed at a level sufficient to ensure satisfactory growth without fattening. Group IV was subjected to the variations and hazards of the desert ranges of Southern Utah. The experiment extended over three years beginning in 1936–37, and the average feeding over the three years was 188½ days—from October to April of each year.

Table 1. Summary of Initial Body Weights and Changes in Weights of Ewe Lambs during the Experiment (averages of three years)

Times when weights were obtained and gains calculated	Gp. I	Gp. II	Gp. III	Gp. IV
	lb.	*lb.*	*lb.*	*lb.*
Initial weight, October	68	68	67	67
Final weight, April	89	95	92	77
Average gain per lamb	21	27	25	10
Following Oct. (or Dec.)*	104	107	104	102
Gain during year	36	39	37	35

* During the years 1936–37 and 1937–38 weighings were carried out in October, but in 1938-39 weighings were in December.

The figures show that the fed lambs were significantly heavier at the end of the feeding period than Group IV lambs, which had spent the winter on the range. During the summer all groups grazed under normal range conditions and, when weighed in the autumn, the disparities had tended to disappear ; at most the differences in weights were only 5 lb., and in the cases of Groups I and III the differences compared with the range group was a mere 2 lb.

Judged on the figures, the extra feeding would scarcely have appeared worthwhile. However, the lambs were followed through to lambing and their performances are recorded in Table 2.

Table 2. Number and Percentage of Ewes Lambing at Two Years of Age in Farm-fed and Range Groups

	Lot-fed Groups			Range Group			
Year*	Number of ewes at breeding time	Number of ewes lambing	Ewes lambing as percentage	Number of ewes at breeding time	Number of ewes lambing	Ewes lambing as percentage	Differences in percentages of ewes lambing
			per cent			*per cent*	*per cent*
1936–37	71	55	77	42	27	64	13
1937–38	70	43	67	45	22	49	18
1938–39	66	36	54.5	36	7	19.4	35.1
Total for 3 years	207	134	64.7	123	56	45.5	19.2

* Year in which fed. Lamb crops obtained in 1938, 1939 and 1940

The figures show a lambing percentage of 19.2 in favour of the fed sheep—a difference too great to be due merely to chance. The Utah workers conclude :

> It is surprising that the special feeding which ended 6–7 months before breeding would have such a pronounced effect upon the lambing rate. A number of trials by various workers have demonstrated that providing a high level of nutrition just prior to and during the breeding season tends to increase the size of the lamb crop, but an effect on reproductive activity as a result of feeding so long before the breeding season is surprising—particularly so since the extra weight gained during the feeding period had practically disappeared by the time of breeding.

The suggestion is then made that the extra feeding may increase the size of the reproductive tract, thus enabling a higher proportion of ewes to be better equipped for breeding. This theory proved to be correct for a later experiment (2), involving slaughtering ewe lambs from range, and fed groups showed the latter to have a more fully developed reproductive tract.

Work on the nutrition of ewe lambs has been started at Aberdeen, and an interim report has been published (3). The problem is being tackled along the lines of reseeding an area of the experimental farm and comparing the performance of ewe lambs wintered on the reseeded area and a group wintered away. Attention is also being paid to the economic implications of the two methods. Taking the lambing seasons 1948 and 1949, no significant difference in fertility between the home and away wintered sheep was observed.

Bangor Experiment A long-term experiment has been started at Bangor with the object of assessing the effect of the place of wintering on the growth and subsequent fertility of the College Farm ewe lambs. Initial results seemed to indicate a profitable field of study, and the Agricultural Research Council generously agreed to provide a grant for the work.

At the College Farm a flock of between 650 and 700 breeding ewes of the Welsh Mountain breed is maintained. In accordance with local practice, it grazes the unenclosed mountain from mid-June to the end of October, at an elevation of between 1,100 and 3,000 feet. The flock spends the winter on the enclosed rough grazings, which lie between 150 and 1,300 feet. Sections of this 400 acres are ploughable, and during the past seven years a small acreage has been reseeded direct each year. The ewes are drafted out at 4½ years of age, and all the ewe lambs, most of which are born in April, have to be retained to keep the flock up to strength. Lambs are weaned in September, and the ewe lambs are sent to lowland farms early in October and return from wintering during the first week in April.

Wintering has to be found each year for some 240 ewe lambs, which involves the use of four different centres, and observations in the past have revealed big differences in the condition of the lambs when they returned ; one centre in particular returned a poor type of animal. The next step was to ascertain the extent of the differences, and so the ewe lambs were given a tattoo number in the ear and weighed before and after returning from wintering. Some interesting results were obtained (4). On their return the sheep are put on to the open mountain and are gathered at the end of October before being tupped. This autumn gathering provides an opportunity of weighing a third time. The results are given in Table 3.

Centre 1, which is situated some 20 miles west of Bangor, provided an average increment during the winter of only 1½ lb. per lamb. However, the sheep from this centre gained more during the summer on the open mountain than the sheep from the other centres. This summer gain was,

however, not sufficient to make good the advantage gained by the other centres during the winter. In an earlier pilot experiment the disparity at the end of the summer was much less. Centre No. 2 situated on the slopes of the Vale of Clwyd in Denbighshire. Centres 3 and 4 are situated on the slopes of the Conway Valley, but Centre 3 is at a higher elevation and on less

Table 3. Summary of Initial Body Weights and Changes in Weights of Ewe Lambs wintered at four different Centres during 1948-49

Times when weights were taken and gains calculated	Centres at which sheep were wintered			
	No. 1	No. 2	No. 3	No. 4
	lb.	*lb.*	*lb.*	*lb.*
October, 1948	41.8	40.8	43.4	42.7
April, 1949	43.3	54.0	52.0	55.4
Average gain per lamb during winter	1.5	13.2	8.6	12.7
October, 1949	56.8	65.0	61.5	66.3
Average gain during year	15.0	24.2	18.1	23.6

fertile land than Centre 4. It is seen, therefore, that considerable differences can exist between different centres—governed largely by the amount of grazing available, but other factors may contribute something to the overall difference. Aspect and climate may exercise some effect. It is perhaps significant that the soil at Centre 1 always appears wetter and does not drain as readily as the other centres.

The performance of the sheep at lambing time is given in Table 4.

Table 4. Number and Percentage of Ewes Lambing at Two Years of Age during April and May, 1950, according to Wintering Centres

Wintering Centre	No. of ewes at breeding time	Number of ewes lambing	Number of barren ewes	Percentage number of ewes lambing
No. 1	53	41	11	78.8
No. 2	52	50	2	96.1
No. 3	46	41	5	89.1
No. 4	62	60	2	96.7

It is seen that the lambing percentage appears to be related to the condition of the ewe lambs at the end of the wintering period, and that lambing percentage within the limits of this experiment appears roughly proportional to the weight gained. The question whether or not there is a statistical significance between the lambing percentages of the different centres is not easy to answer on the results of one year's figures. However, it can be said that on the basis of the "X^2 test" of significance the ewes at Centre 1 have done appreciably worse than those at the other centres.

Although the numbers of ewes lambing provide the critical figures for the interpretation of this experiment, it is as well to point out that a number of the lambs died either at or very soon after birth. Taking the lambing period as a whole, weather conditions were not favourable and a total of 39 lambs died. It is interesting to note that the highest proportion of deaths, numbering 14, came from the ewes which had wintered at Centre 1. In this connection, behaviour studies of hill ewes at lambing time (for example, the time taken for the lamb to get on to its feet to suck would be one im-

portant aspect) might yield interesting results. A study of this nature would be particularly valuable when related to any scheme of progeny testing of hill rams, and might possibly make some contribution to an evaluation of the "hardiness" factor.

The results of one year's work must clearly be accepted with some reserve, and it is proposed to continue the study for a further two years. Sheep wintered during 1949–50 were sent to five centres, an additional centre having been obtained in the Lleyn Peninsula.

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AGRICULTURAL DEVELOPMENT IN FRANCE

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WE think of French farming as being mainly carried on by peasants, on smaller holdings than are usual in England, with out-of-date methods. This is widely true, in so far as anything can be true of the immensely varied nature of French farming ; but great changes are taking place. The French government has plans for considerable investment in and improvement of agriculture, and although the structure of farming there will probably remain much the same, production is expanding fast, new methods are being tried and adopted, and it is worth while for the English farmer " to look over the hedge," to see what his neighbour is doing.

First, the best farmers everywhere are making tremendous individual efforts to raise their outputs. In one hour's drive through the great corn region outside Paris, I saw six combine harvesters at work. The Marshall Aid credits have increased the supply of American machinery, and many farmers are keen to get some of it if they can. I visited a dairy farm near Clermont-Ferrand, and was shown by a proud owner a fine herd of Friesians, carefully fed on lucerne and other home-grown crops and silage. They were machine milked and their yields recorded steadily at about the 1,000 gallon mark. In Normandy, too, there are many fine herds, mostly of the Norman breed, a dual-purpose type which everyone I questioned insisted was a fine milker and an excellent beef beast. It is rather like the neighbouring Channel Island breeds, golden, but with definite black markings, often in stripes, on the back.

The Norman farmers are great apple growers, and I met several who are very keen and expert in the cider apple trade. Some still make cider with the old stone mill, but others have modern plants. The trees seem taller than in England, and their branches higher off the ground ; the pasture below is generally grazed by cattle. Many of the farms in Normandy were badly damaged in the fighting. Whole villages were destroyed, and a

farmer with no out-buildings left counts himself lucky to have the farmhouse still standing. In the face of this, the farmers are making magnificent efforts not just to carry on, but to do better than before. Here again, there are combine harvesters in use, and some farmers are using tanks and reservoirs for the grain in place of sacks. The standard of cultivation on the farms I visited was high : yields of wheat were estimated at between 28 and 40 cwt. per acre, the crops were standing well and were fairly clean. Little time in cultivation was lost ; I found one man harvesting and another breaking up the stubble the same day. Very often the fields are in strips undivided by a hedge or similar boundary. This must limit the farmer's choice of use between pasture and arable, and usually the farming seems much more specialized than in England. One passes through miles of pasture and orchards, then suddenly enters an area where almost every strip is in arable cultivation. The strips belonging to any one farm are also scattered, but this is not too great a hindrance, provided they are sufficiently large to allow the use of machinery, and give combine harvesters perhaps a day's work in each of them. The combines often have a wider cut than is used in England. Indeed, one advantage of the strips is the space for manoeuvring which the absence of gates and hedges allows.

It is true that in general French farming is still of a peasant structure, but on the larger farms, where labour is employed, the farmers find it a problem to get men capable of using machinery. There were only 35,000 tractors in France before the war, and French agriculture did not experience the great drive for mechanization that the war caused in Britain. Thus France is, to some extent, facing problems which British farmers have overcome, and one of these is the training of men to use and maintain farm machinery. One farmer I met had solved the difficulty by getting a fully qualified mechanic from the town to move into the country—by the offer of a house !

Revival of Rice Growing One of the best examples of the technical initiative of the French farmer is the revival of rice growing in the Rhone delta in the far south. Rice growing had died out in the early 1930s because prices were too low, and was restarted only during the war. With the aid of good prices, fixed at three and a half times the price of wheat, there has been a huge expansion—from 1,200 acres in 1942, 2,500 acres in 1946, to about 30,000 acres in 1949. This is an immense technical achievement, for to grow rice the fields have to be irrigated and must remain flooded right up to harvest. The preparation of the fields has been heavy work, but a greater problem was presented by the fact that the rice had to be harvested in September-October, at the same time as the vine harvest. Hand labour was very scarce, and in any event too costly. The use of a binder is impracticable because the grain would shed too much, and a combine harvester would be too heavy. Nothing daunted, the farmers have devised ways of draining the fields very slowly as the harvest approaches to make the ground as firm as they dare, and they have now adapted some harvesters to run not on wheels but on tracks, like tanks, giving the largest possible track-face to spread the weight and prevent the machines getting stuck. There are still difficulties—the farmers would like some new, early-maturing varieties of rice which would also stand better when ripe, and they would like a new weed-killer to attack the worst weeds of the rice fields (they are immune from the ordinary type of hormone weed-killer). But the outstanding fact is that by their technical initiative the farmers have achieved this great expansion of rice growing. It is important, however, to notice

that they have been helped by three things—steady, guaranteed prices, co-operative machine pools, and an experienced Government advisory service.

Widespread Co-operative System Next to the efforts of individual farmers, which must always be the mainspring of agricultural expansion and progress, come their co-operative efforts. In France there does not seem to be the development by commercial firms to meet the farmers' needs that there has been in England. It is difficult to say why ; it may be that conditions are too varied to allow large firms to cover whole regions, and distances are greater ; it may be partly due to the peasants' distrust of the dealer, and the dealer's fear that the trade may not be large in any event ; but it is clear that the co-operative system is very congenial and helpful to the French farmer. The farmers' co-operatives cover almost everything—the buying of seeds, fertilizers, tools ; the providing of credit ; the organization of machinery pools ; and, most important, marketing facilities. They often have excellent arrangements for instructing young farmers, partly by correspondence courses, partly by classes, and by visits at the less busy times of the year. One section, covering two *départements* had 4,300 members taking courses. The co-operatives also offer insurance, legal advice, and help with the reconstruction of damaged farms, and most co-operatives publish a weekly newspaper. One organization I visited handles for sale one-half of all wheat grown in the region. It has good storage and drying facilities, but not enough for all the combine-harvested corn in a wet harvest. They are, however, soon moving to a new site, and plan to erect there storage and drying facilities for all the grain they are likely to handle. Another organization covers a large part of Brittany, where intensive peasant cultivation is still predominant. This unit handles 40,000–50,000 eggs a day, collecting from farms three times a week. The fruit section handles strawberries from an area where they are the main crop, and at the height of the season sends four aeroplane loads a day to England. The machinery pool had 250 members in June, 1947, and 3,000 in June, 1948. These are but a few examples of the surge of activity and enterprise the co-operatives are showing in everything that can help farming forward.

The structure of the co-operatives is very complex and varied, but I saw several on the following basis. There is usually one co-operative for a *département*. Within its organization there are separate branches for buying, selling and so forth, and the farmer joins those branches in which he is interested by a capital subscription equivalent to between 10s. and £2 each. The co-operative pays 5 per cent per year on the subscription, and a further dividend based on the volume of each farmer's transactions. No one is compelled to offer any part of his produce for sale through the co-operative ; at least in those I visited. The structure above *département* level is both by region and by type of farming, and leads eventually to a national body—the *Confédération Générale d'Agriculture*. It is interesting to find that the *C.G.A.* has been involved to some extent in political troubles and differences, and I found the success of our own National Farmers' Union in avoiding this widely envied. There is no special moral for English farmers to draw from the success of co-operation in France, because the conditions are so different, but it is important to realize again the initiative that is being shown and the progress made. This is a very cheering fact when the world is short of food ; it is equally a lesson that if there is to be competition again in some products, we shall have very competent neighbours, and possibly rivals.

Action by Government A great deal that is beyond the scope of the individual farmer is being done by Government action. First, there are advisory services, similar to the N.A.A.S., which, though finding it difficult to spread new methods widely and quickly, are working steadily and confidently, and who are on the best of terms with the progressive farmers. Second, there are various regulations that will bring improvements, such as a strict licensing of bulls, by which a bull that is not certified may not serve any stock other than that of the owner. Artificial insemination is being used in many areas ; the system is similar to our own, and the fees are about the same. In some areas the quality of the livestock is very low, through bad breeding, and the A.I. services are expected to play the major part in defining and improving the breeds. I visited one farm where pedigree Charrolais cattle are bred, and two of the bulls were being sold to the insemination co-operative. The Charrolais is a beef breed, all white, and related in the distant past to our Durham Shorthorn.

The other agricultural work of the Government is mainly concerned with drainage and replanning holdings, both on a grand scale. I walked over part of one drainage scheme covering 17,000 acres of land in all and involving about 1,700 landlords and farmers. The main stream in the area has been re-dug for about 10 miles, straightened, and its rate of fall increased. Three thousand trees have been felled and over 20 miles of fencing erected. The cost is met 60 per cent from public funds, the balance of 40 per cent by the landowners, who are allowed thirty years in which to pay, making the annual contribution equal to about 4s. an acre. It has been difficult to meet every owner's wishes, plans, and objections, but sufficient agreement has been secured without compulsory purchase ; everyone was pleased to be harvesting excellent crops, often about 2–2½ tons of wheat to the acre of this wonderful soil, where in 1948, almost the entire harvest was lost in summer floods. The personal problems involved in redistributing holdings are much greater. This is being done because by the sub-division of land under the French laws of inheritance, the strips have become too small and scattered for economic cultivation. In this way some of the richest soil has been lost to production. In one village the average size of the few holdings cultivated before redivision was 40–60 acres, held in 60–70 separate scattered strips. The process is a long one, involving grading of the soil of each strip, assessment, and often, objection, but it is being completed. I stood on the boundary of two villages—one that had carried out its replanning, and one that had not. The latter was almost derelict, an odd cultivated strip here and there, no bigger than an allotment ; the other, with its new holdings growing crops of the quality that has made the plain of Limagnes famous in France. Here I met a farmer who is sharing machinery with his brothers ; the whole of their harvest on their replanned holdings had been done with a combine harvester and an automatic pick-up baler !

It is very difficult to say much about prices and costs, or farmers' incomes. Last summer prices for only two commodities were fixed by the Government —milk and wheat ; and I heard complaints that both were too low. Other prices are uncontrolled, and, I gathered, very uncertain and fluctuating. Many farmers would like to see them fixed by the Government, but France is in the difficult position of trying to expand her production for export, being already self-sufficient at home. If the exports fall, the home market is liable to be flooded. Production costs vary, too, with the techniques employed, efficient and inefficient, by different farmers ; also by reason of an unusual rent structure. In any event, with so much family labour, they are almost impossible to compute. In general, I think the independent farmer's

income remains low, as one would expect in a country where there are something like 2½–3 million of them, as against only one million paid workers.

A Progressive Element in French Farming It remains true then, that France still has a predominantly peasant agriculture, and it is problematical to what extent mechanization will become really widespread. The average is admittedly much lower than in the cases I have quoted. But I have emphasized the striking progress that is being made because it represents, first, a great store of up-to-date technical knowledge that can spread as the demand for further expansion arises, and second, because it is evidence of a great progressive element of leadership in French farming. It is important to remember that during the war the Germans took nearly all the French farm output, and underproduction was consequently a virtue, even where shortage of fertilizers and everything else did not compel it. Now that trend has to be reversed. But that is all the more reason to recognize clearly that great progress is being made, to congratulate French farmers on their work—intended as it is to feed Europe with scarce dollar-area foods—and to study French methods and see if we can learn from them. Most of all, we must not be complacent with what we may think are our own special advantages, but must continue to seek to raise our own efficiency with the same drive and enthusiasm as that with which the leaders of French farming are seeking to raise theirs.

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EMPIRE HARDWOODS IN GLASSHOUSE CONSTRUCTION

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FOR long life and satisfactory performance timber used in glasshouse construction must fulfil certain exacting requirements. Temperature and humidity conditions under glass are extremely favourable to rotting, and any timber used must first be resistant to decay, or if not naturally so, easily impregnated with suitable preservatives. To give the best light conditions in early spring, roof members must be as small as possible and the timber must therefore have good strength for size. From the builder's point of view it must work easily and be resilient. To the nurseryman, other factors considered, it must be as cheap as possible.

In the years immediately before 1939 four timbers were used extensively for glasshouse work—Baltic Redwood (*Pinus sylvestris*), Whitewood (*Picea abies*), British Columbian Pine (*Pseudotsuga taxifolia*) and Western Red Cedar (*Thuya plicata*). All four species are imported softwoods, the first two from the Baltic and Russia, and the latter two from Canada and the U.S.A. Under present economic conditions softwoods are scarce and their supply is subject to strict control. Moreover, because of the dollar shortage, relatively little timber is imported from North America. The bulk of the

softwood allocated for glasshouse work is taken up for essential repairs and rebuilding and only very small quantities are available for new construction.

Tests with African Hardwoods Since control was removed from the sale, price and importation of all hardwoods (except a few special kinds), the interest of growers and horticultural builders has turned to the possibility of using certain hardwoods for glasshouse construction. Until glasshouses built from these timbers have stood for several years, it is impossible to judge the value of the wood for this purpose, but sufficient information is available on several species to give an indication of their possibilities and provide guidance to growers contemplating using them. All the species used so far have come from West and Tropical Africa. Brief descriptions of the species so far tested or suggested for use are given below, together with their properties.

Abura (*Mitragyna stipulosa*). This is a pinkish-brown timber, usually plain and without figure. It has a moderately straight grain, a density of 36 lb. per cubic foot, resembles common elm in its mechanical properties and possesses medium strength and hardness. Most samples work easily but the timber does not nail too well ; thin gauge nails must be used. The timber is not resistant to decay and rots very quickly, but it is moderately easy to impregnate with preservative. Abura has been used as a general utility timber and supplies are adequate for present demand but because of its poor durability it is not very suitable for glasshouse work.

Afara (Limba) *Terminalia superba*. The wood is normally light coloured, resembling light oak. It is straight grained and has a density of 35 lbs. per cubic foot. Little information is available on its strength properties but the heartwood is reported often to be brittle. The timber works fairly easily but has a tendency to split when nailed. It is not resistant to decay and does not take preservative easily. The species has been used by at least one firm who favour it for some work but the properties do not recommend it for glasshouse construction. It is abundant and relatively cheap.

Agba (*Gossweilerodendron balsamiferum*). The timber is a light buff colour, straight grained, with a fairly close, even texture and a density of 30 lb. per cubic foot. It is clear and free from knots, seasons well, works easily and nails well. Tests show that it has similar strength properties to Baltic Redwood but is much more durable and naturally resistant to decay. From limited experience the timber has been found to be resistant to impregnation with preservatives, although this is not of importance because of its natural durability. Agba has been used as a lightweight, general utility, joinery timber and is very good for glasshouse construction. It is generally regarded favourably by the trade, the only disadvantages being that it is not easy to obtain in long lengths and it tends to pull out of line after manufacture in small section moulds. The timber is available in quantity and supplies appear ample to meet any demand likely to arise.

Idigbo (*Terminalia ivorensis*). The wood is of a pale yellow colour with a zonal figure resembling that of oak and a straight or slightly irregular grain. Average samples have a density of 30 lb. per cubic foot ; it works fairly easily and nails fairly well. The timber generally has good strength properties but the centre of large logs is very brittle with correspondingly poor strength. This brittle heart zone must be rejected for glasshouse work and this, coupled with a tendency of the timber to split, makes it wasteful and expensive. Idigbo is very resistant to impregnation by preservatives but natural resistance to decay is good. Imports so far have been on a small scale.

Mansonia (*Mansonia altissima*) is a greyish-brown timber relieved by lighter and darker bands. It is straight grained, has a density of 38 lb. per cubic foot, seasons well and has good strength and bending qualities. The timber is very resistant to impregnation by preservatives, but it is naturally very resistant to decay. It works easily and has fairly good nailing properties. The dust from dry wood may cause a dermatitis on some workers and for this reason it may not be pleasant to handle. Unfortunately, the wood can be obtained only in short lengths and is expensive. Importations so far have been small.

Niankom (Niangon) (*Tarrietia utilis*) is a recent importation and only limited information is available on its properties. The timber is reddish-brown with a golden lustre. It is moderately hard and heavy, with a density of 35–45 lb. per cubic foot. The texture is rather open and samples feel rather greasy, due to the presence of a gummy material. It seasons satisfactorily but may develop end splits if not carefully handled. The wood works easily, nails well, and is moderately resistant to decay, being similar to the heartwood of Baltic Redwood. It can be treated satisfactorily with preservative. The Forest Products Research Laboratory has a sample consignment under investigation, from which it is hoped to get more definite information on its technical properties. It is being used by at least one firm of horticultural builders, who state that it is very good for glasshouse work and comparable in its properties and uses to Agba. Importations are increasing and supplies are sufficient to meet demand.

Obechi (*Triplochiton scleroxylon*) is a pale straw-coloured wood with no clear distinction between heartwood and sapwood. The texture is open but firm and even, it has a density of about 24 lb. per cubic foot, is clear and free from knots and works easily. Before the war Obechi was used considerably in a number of branches of the builders' joinery trade and is now a popular softwood substitute. It is hazardous to buy the timber in the log as often there is considerable waste, particularly if the quality is poor. For glasshouse work it is recommended that only good quality, kiln-dried timber should be used. The species is not resistant to decay, and for this reason is not recommended by some builders. The sapwood can easily be impregnated with preservative but the heartwood is resistant to treatment. Some builders like the timber because of its relative cheapness and the fact that more is known about its handling (it has been used longer than other species). Other builders are doubtful about its use, except as a stop-gap in the present softwood shortage. The timber is being imported in quantity and is readily available.

Red Meranti (*Shorea* sp.). This timber is imported from S.E. Asia and not from Africa as are all the other timbers described. The wood is reddish brown in colour somewhat resembling mahogany but coarser in texture and having an average density of 36 lb. per cubic foot. Wood from the centre of the log is apt to be brittle and weak and should not be used where strength is required. Normally the timber has good strength properties and is moderately resistant to decay. The species are extremely resistant to impregnation with preservative. The timber works fairly easily and nails well. Supplies are large and the quantity of good quality timber available is increasing. This timber has not, so far as is known, been used for glasshouse construction but it has been suggested as worthy of trial.

Podo (*Podocarpus* sp.) is not a hardwood but is included here as the timber is permit-free and is a good substitute for the commonly used softwoods. Although strictly a softwood it differs from typical examples in having no clearly defined annual rings. The timber is of a light yellowish colour,

straight grained, uniform in texture and easily worked but has a tendency to split when nailed. It is about 50 per cent harder than Baltic Redwood, but has approximately the same density (32 lb. per cubic foot) and similar strength properties. It rots very easily but is readily impregnated with preservatives. The best grades have been used as a high-class joinery timber and, although supplies are plentiful, it has not yet been imported in quantity and the present demand has overtaken the rate of importation.

Possible Future Use It is difficult to assess how far these timbers will be used in future glasshouse construction, but so long as the supply of softwoods remains difficult it is expected that they will be used increasingly. When the softwood position eases it is considered that most nurserymen and builders will revert to the timbers used before 1939 but a few of the hardwoods may be used permanently after trial. The writer knows of one three-acre block and several smaller areas which have been built in Hertfordshire from these hardwoods, and similar building is probably taking place generally. The main consideration against their use is the high cost. The table opposite shows the relative cost of most of the timbers described, taking Baltic Redwood as 100. It should be noted, however, that they are only a rough guide. The tendency with many of these timbers is for the price to be relatively low when first imported and then to rise as the properties and uses become more widely known and the demand increases.

Summary Agba, Niankom, Idigbo, Mansonia and Meranti are all suitable for glasshouse work as regards weight, strength, natural durability and availability, but Idigbo and Mansonia are very expensive and on this account will probably be little used. Agba and Niankom are good timbers for this class of work and if properly treated last longer than Baltic Redwood. Agba has a life at least double that of Redwood, and it should be remembered that at its present price (double that of softwood) the increased cost per acre of glass is only about £2,000 or 16 per cent on present building costs. Obechi, Abura and Afara are not so suitable because of their lack of natural durability, though they are relatively cheap. Abura and Afara can be regarded only as stop-gaps, though Obechi is being used and is liked by some builders. To give satisfactory performance, the latter must be of good quality and pressure-treated with preservative. Podo has not yet been used to any appreciable extent but, if pressure-treated, it should be very satisfactory. Looking to the future, Agba, Niankom and possibly Meranti may become commonly used glasshouse timbers, even when licensing restrictions are removed from softwood. The extent to which they may become popular depends largely on the availability and price of softwood ; because of higher extraction and freight costs the price of these hardwoods is always likely to be more than for softwood.

The list of timbers described is not claimed to be exhaustive, as new species are constantly being imported and tried as substitutes for softwood. Much of the information used in the preparation of this article has been provided by various Government Departments and the trade, and the list is as complete as possible up to the time of writing. The author is indebted to, and wishes to thank, the following for their kind help and co-operation : the Director, Forest Products Research Laboratory, Princes Risborough ; the Assistant Area Officer, Timber Control, Area 5 ; Messrs. Duncan Tucker (Tottenham) Ltd. ; Messrs. Hortus Ltd., Barking ; Messrs. Boulton and Paul, Ltd., Norwich, and Messrs. J. Gliksten and Son, Ltd., London.

Summary of the Technical Details of the West African Hardwoods described and a comparison with Softwoods

Standard Name	Botanical Species	Density *lb. per cu. ft.*	Ease of Impregnation	Natural Durability	Glasshouse Qualities	Relative Cost
Abura	*Mitraguna stipulosa and M. ciliata*	36	Moderately resistant	very poor	poor	170
Afara	*Terminalia superba*	35	resistant	poor	doubtful	170
Agba	*Gossweilerodendron balsamiferum*	30	resistant	good	very good	200
Idigbo	*Terminalia ivorensis*	30	extremely resistant	good	very good	250
Mansonia	*Mansonia altissima*	38	very resistant	very good	very good	300
Niankom (Niangon)	*Tarrietia utilis*	35—45	moderately resistant	fairly good	good	200
Obechi	*Triplochiton scleroxylon*	24	sapwood permeable heartwood resistant	poor	doubtful	170
Red Meranti	*Shorea* sp.	36	very resistant	good	good	175
Podo	*Podocarpus* sp.	32	permeable	poor	good	Not known
Baltic Redwood	*Pinus sylvestris*	32	permeable	fair	good	100
Western Red Cedar	*Thuya plicata*	24	very resistant	very good	good	160

FARMING AFFAIRS

Corn Harvest Reflections Timely rain is of the essence of productive farming, and until July it was almost ideally helpful. Thereafter we had too much of a good thing. Exceptionally promising crops were largely spoiled, in some cases ruined. Wet harvests will, doubtless, recur periodically, indeed in some parts of the west and north they are the rule rather than the exception. In one way or another most farmers try to make the best of a bad job. Let us see how they set about it, adapting, as usual, means to circumstances. The combine harvester goes far to solve the problem for those operating on a large scale and who can have their grain artificially dried when too moist for safe storage. The complete outfit, however, involves heavy capital outlay, and the individual ownership of a drier as well as a combine would not be justified economically on the ordinary "mixed" farm, unless it could be put to other use such as the drying of forage seed or green crop. In an ordinary season a drier is not essential, nor even the individual ownership of a combine where the work can be contracted for ; but in emergencies like the last harvest dependence on other people either for combining or drying is unavoidably apt to let the farmer down. For some years, at least, most farmers will continue with the binder method, necessitating, though it does, stacking and threshing as well. Many combine farmers have little use for straw unless for litter. They favour short-strawed varieties of cereals which, however, are not such efficient weed controllers as the more luxuriant kinds, and the worst weeds—the grassy ones—are not susceptible to sprays. Straw of good length and unbroken, will be needed for thatching stacks and clamps until far more provision is made for shed storage. Straw, particularly oat straw, makes valuable fodder, but for this purpose it needs to be cut before it is dead ripe, as required for combining. It is true that oats can be cut at the ordinary time by binder, without sheafing, swathed to dry on a long stubble and picked up by combine from the swath later. But it will be less nutritious than sheafed straw and few farms can bear the additional capital overheads which mechanical reserve capacity entails.

With regard to swathing, it is doubtful whether sufficient consideration has been given to it as a means of harvesting corn in a wet season. My barley crop was badly laid and twisted. We cut it by binder fitted with lifting fingers, but many sheaves were thrown out untied. Instead of being bound and stooked, they were assembled and cocked, care being taken to lay the heads inwards and upwards. Some of these cocks remained in the field for a month, yet when picked up they were perfectly dry, there was no sprouting, and rain did not seem to have penetrated at all. The same method was adopted with a mixed crop of oats and peas which the binder would not tackle. It was therefore cut by mower, all wheels straddling the swath. This was cocked in the same way as the barley and ultimately stacked in excellent condition, in spite of rain almost every other day.

The importance of prompt and efficient stooking was very convincingly demonstrated. Unstooked and fallen sheaves, once thoroughly wetted, dry slowly and in close, muggy weather soon sprout. This applies also to end sheaves when set down to lean towards the centre of the stook, and, of course, to stooks set near a hedge. It is more important that stooks be made to stand than that they should occupy a north-east–south-west direction, and it is easier and quicker to keep to the binder line. Sprouting, even in very rainy weather, can be largely prevented if the stooks are properly made, and sheaves that may have been blown down are set up without delay. Furthermore, standing stooks dry very quickly after rain when the sun shines

or the wind blows. I recall a Saturday when it rained all day and the following night. Sunday was breezy and sunny. We set off to cart on Monday morning, got one load up quite dry, when down came the rain again. A passing neighbour told me he had examined the stooks on Sunday afternoon and found them quite dry then. We had missed an opportunity. Incidentally, the crop was Atle spring wheat, thick but all standing and neat sheaves that stayed put. For undersowing, Atle is preferable to either oats or barley and is safer than autumn wheat where Take-all or Eyespot is to be feared.

To save time, more corn than usual was stacked in the field. Unfortunately, stacks are not always built to turn rain, and in a wet season cannot be thatched quickly enough for protection. The practice is to build from a standing position with the aid of a pitch-fork. The sheaves are thus laid loosely and to prevent their slipping out of the heads are made to incline slightly downwards towards the centre. The stack settles almost to a basin shape internally, with the result that rain, especially driving rain, may run right in. Farther north, where the stacks are smaller, the custom is to "knee" the sheaves and bind each course in such a way as to keep the heart up. A stack so built needs little or no thatch. The best alternative is, of course, a Dutch barn. Not only does it save thatching and prevent waste, but it also facilitates threshing which, in the field, has constantly been interrupted by rain.

J. G. Stewart

Farming Cameo
2. Ellesmere–Oswestry, Shropshire

The Ellesmere and Oswestry Rural Districts of Shropshire are bordered on the north and west by the Welsh counties of Flintshire (detached), Denbighshire and Montgomeryshire, by the winding River Severn in the south, and by a purely arbitrary division twenty miles to the east. The 150 odd square miles of agricultural land varies from the hill and marginal farms on the Welsh borders to the dairy and mixed farms of the lowlands. It is an area of diverse soil formations: the cold river land of Melverley, the light sand and gravel of Knockin, West Felton and Colesmere, the peaty soil of Baggymoor, and the heavier soils of Whittington, St. Martin's and Ellesmere—a complex geological formation brought about by glaciers from the north and west meeting during the Ice Age. The rainfall is 40 inches in the vicinity of the hills, and decreases to 26 inches at the eastern boundary.

The chief market town, Oswestry, is known to farmers all over the country for its large livestock auction, and on Wednesdays the town is crowded with English and Welsh farmers. It is often said that there is more Welsh spoken in Oswestry on Wednesdays than in Welshpool (Montgomery) on Mondays ! A noticeable feature of the Oswestry area is the number of farmers and farms with Welsh names.

Except for a few cattle rearing and sheep farms in the west, the main industry is the production of milk, to which it has been possible to add 4,000 acres of wheat, 2,000 acres of sugar beet and 2,000 acres of potatoes annually. The standard of farming is high. It has to be high because in the parish of Ellesmere Rural, one of the largest parishes in England, there is a dairy cattle population of 10,000 head on 20,000 acres.

Dairy farming is a specialized business. Some figures taken from one of the better farms in the district are interesting. This is a 125-acre farm, on which the cropping is 30 acres of mixed corn, 15 acres of sugar, 20 acres of temporary ley, and 60 acres of direct reseeded grassland. It carries a stock of grading-up attested Friesian cattle, made up of 36 milking cows and heifers,

37 young stock and 2 stock bulls. The herd average has been raised from 900 gallons per cow in 1946 to 1,200 gallons per cow in 1950. Heifers calve at exactly two years old and average 900–1,000 gallons per heifer, the lactation period for all animals being 305 days.

Winter milk is the main object, the cows calving down in September each year. The farmer aims at reducing his feedingstuff costs by extending the grazing period in the autumn and spring and utilizing sugar beet tops and grass silage during December, January and February.

All this has been achieved by good all-round management, investment in good stock bulls, the ploughing and reseeding of all the permanent grassland, and the methodical application of ample and suitable fertilizer.

We could do with more such farms in the district, and we hope that in time that will come.

M. Garton
District Advisory Officer

Grain Drying by Silo and Platform Drill When combine harvesters were first introduced into Britain from America it was expected that their use might have to be confined to the drier parts of the country. Indeed, many people believed that even in the dry counties they would be successful only in reasonably dry summers. Experience over the years has, however, vindicated the use of the combine in nearly all parts of the country and in all kinds of weather. This year of wet harvest has demonstrated beyond question that on many farms the combine has saved crops which would have been spoilt had they been left to the binder-and-stook method of harvesting. Of course, artificial drying has been necessary during most of the harvest, and this season also has vindicated some newer, simpler forms of driers. The silo drier and the platform drier for bagged grain have been so successful that it seems as though one or other of these two kinds of installation can provide adequate insurance against a bad harvesting season for the farmer who wants to use a combine and yet has not a sufficient acreage of grain to justify the installation of one of the more expensive types of grain drying machines.

The silo type of plant is proving to be of special interest to those farmers who wish to provide for bulk storage, as well as for conditioning of the grain. The principle depends upon the fact that all grain that is ripe and reasonably dry tends to come into a state of equilibrium with the moisture contained in the air surrounding it. The silo drier provides means of controlling the grain atmosphere, and through it the moisture content of the grain itself.

A silo drying and storage installation consists of a grain-receiving hopper or pit, grain conveyors, a grain cleaner, silos or bins with porous floors, a sacking-off device, and a ventilating fan with a heater unit. The amount of moisture in air varies with the weather, and the capacity of the air for holding the moisture varies with its temperature. When a state of equilibrium has been reached between the moisture content of the grain and the moisture content of the air, no further drying takes place, but if the temperature of the air is raised its capacity for holding water is increased and drying continues. In silo driers, slightly warmed air is passed up through the mass of grain which is contained in the shallow silos. It is blown through the porous floor of each silo, and gradually dries the grain down to a moisture content in equilibrium with the air being blown in. The grain at the base of the silo is dried first, and the drying zone moves progressively up from the bottom, until all the grain is dried. The heat for warming the air is generally provided by electricity. An installation of drying silos can be built for about

£10 per ton of storage, and the rate of drying is round about ½ per cent in 24 hours.

The platform drier uses a simple installation, whereby a large volume of heated air is forced through the grain in bags. It consists of a heater unit with fan to provide the warm air ; a concrete platform with air ducts beneath and gratings in the top, over which the bags of grain are laid. The heater unit is usually oil fired and generally consists of a proprietary oil burner with suitable combustion chamber mounted in a tight steel casing. The casing outlet is connected to a ventilating fan which draws air through the hot combustion chamber and delivers it mixed with the products of combustion to the ducts and bags resting on the platform gratings. The fan drive is arranged so that either an electric motor or a small engine, 3–4 h.p., can be used ; the fuel pump and compressor for the burner are driven by belts from the fan impeller shaft. The complete unit is designed to run automatically and unattended, except for routine lubrication and fuel replenishment. Protection against power and fuel failure is provided.

A usual type of platform drier takes forty 1-cwt. bags at a batch and costs about £300–£400. The rate of moisture removal from the grain is about 1 per cent per hour, and an installation of this kind can deal satisfactorily with at least 100 tons of grain in a season. Against the small cost of installation, it must be remembered that the handling of the bags calls for considerable labour and that, unlike the silo drier, the platform drier does not of itself provide any storage capacity.

H. J. Hine

Rothamsted Experimental Station Report for 1949 The Rothamsted annual reports are consistently admirable for the way in which they give an insight into the coordination of research ; how work at one centre can be advantageously linked with that carried out elsewhere and, particularly, how it can be applied to the solution of practical farming difficulties. The Report for 1949 includes many interesting points bearing directly on farming problems, among which mention may be made of the following.

The field plots at Rothamsted, comparing deep and shallow ploughing, continue to show consistent gains in favour of deep ploughing with certain crops, notably potatoes and sugar beet. Yields of potatoes were a ton per acre greater on deep-ploughed plots when potash was put in the rows (in itself a form of fertilizer placement) in comparison with the shallow-ploughed plots. Curiously enough, much less consistent results were obtained in the large series of experiments carried out latterly in collaboration with the Advisory Service. Deep ploughing results obtained in 1949 confirm the impression that part of the benefit due to deep ploughing is due to the production of a cleaner seedbed.

Experiments on the irrigation of sugar beet were carried out during the exceptionally dry summer of 1949. Applying 4 inches of irrigation water increased the yield of sugar by as much as 15 cwt. per acre, as compared with the dry, unirrigated, plots. Some of the plots were irrigated at the discretion of the farmer (experienced in irrigating horticultural crops) ; others were treated on the basis of meteorological measurements made locally. The benefit from irrigation was greatest when the amount of water applied was based on local meteorological data. A full account of these interesting experiments is given on pages 98–101 of the Report.

Further results of fertilizer trials on acid soils are consistent with the view that the special merit of water-soluble phosphate (e.g., superphosphate, in contrast to basic slag or ground mineral phosphate which have relatively

greater residual effects on acid soils) is that it stimulates the early root growth and establishment of crops when applied at or shortly before sowing, a factor which may be very important in a dry spring.

Farmers who find apparently unchanged pellets of granulated fertilizers at the end of the season will be reassured to know that the outward diffusion of plant nutrients in the pellets is rapid, and that the pellet consists of little more than the gypsum used in manufacturing the fertilizer granules.

Fertilizer placement experiments with combine drills show, so far, that for sugar beet and mangolds there is little benefit to be derived from placing fertilizer near the seed instead of broadcasting it, except the labour saved by sowing and applying the fertilizer in one operation. On the other hand, three years of experiment on the manuring of peas for threshing have shown increases in the yield of threshed peas of 1.5 to 2.8 cwt. per acre in favour of the placement method of distribution.

The Bacteriology Department in common with other departments at Rothamsted is collaborating with the National Agricultural Advisory Service. A particular instance is the assistance which is being sought by the Department from the Advisory Bacteriologists in carrying out a survey of different soil types in connection with a comparison of microscope counts with plate counts of soil bacteria. It appears that plate counts may be disclosing only a fraction of the soils' bacterial flora. The survey is expected to throw further light on this fundamental question.

The Statistical Department is conducting further surveys, of which the survey of Fertilizer Practice mentioned in reviewing the 1948 Report* is the prototype. For example, a survey of marginal land is being undertaken to discover how far land, which is not eligible for the full benefits of the Hill Farming Act (e.g., land not in the main producing cash crops, fat stock or milk), can be made productive and what expenditure is necessary to achieve this. The results of the maincrop potato survey obtained during the year of the Report again emphasize the benefit on yield of early planting. A survey of opencast coal sites is being planned.

Studies of the persistence of DDT on cabbage leaves by the Insecticides and Fungicides Department have indicated that losses in the effectiveness of residual films of DDT, due to sunlight and rainfall, are of negligible importance compared with losses due to the attentuation of such films through the growth of the leaf.

The now well-established use of agricultural salt for sugar beet has been the subject of a long-term experiment to find whether continued application of salt causes soil deterioration, and whether salt applications become progressively less effective in the course of time when continuously applied.

At Rothamsted the continued use of salt produced visible effects on the physical state of the surface soil without, however, appearing to interfere with the cropping capacity of the soil for sugar beet or for barley which was used to break up a two-course rotation of sugar beet.

Work on exotic crops at the Woburn Farm included trials of American maize hybrids. The year 1949 was favourable to ripening, and from 1 to just over 2 tons of dried grain per acre were harvested, according to the variety used. This crop appears to have possibilities as a feedingstuff, especially for the smallholder. The yields obtained with seed grown on in this country tend, however, to be lower than those from freshly imported seed.

One of the two Reviews included in the 1949 Report (these articles summarize the present position of a particular line of research) deals with work

*_Agriculture_, 1950, **57**, 138.

on nutrition problems in forest nurseries, an interesting new field of research. The second review concerns the relations between soil cultivation and crop yields. In this a good deal of experimental evidence is given, showing that many of the reasons advanced by farmers and farm advisers for different cultivation practices can now be shown to be invalid.

A. J. L. Lawrence

BOOK REVIEWS

The Chilterns (Vision of England Series). J. H. B. Peel. Paul Elek. 15s.

The general reader will find no small pleasure in this tribute (for such, I think, it may justly be called) to the loveliness and interest of the Chiltern Hills—as they were and as they are today. Until the close of the seventeenth century, the Hills were "a dark and mysterious realm . . . a haven of outlaws and ruffians". Indeed it is interesting to recall that the Stewardship of the Chiltern Hundreds (now merely a formality in parliamentary procedure when a member wishes to resign his seat) was instituted to suppress these rogues and vagabonds. But the tempo of village life has not changed greatly with advancing years, although the Chiltern population has fluctuated with the times. "At the Norman Conquest the population per square mile in the Vale and foothills was about fifty persons; in the Chilterns, only twenty. There are tracts of country near Bow Brickhill where the population has not greatly changed in 800 years. On the other hand, High Wycombe and Slough together have more inhabitants than did the County of Oxford in 1066. The rural exodus at the time of the Industrial Revolution depleted many Chiltern villages, and a few have entirely disappeared. For instance, Caldecote, below Bow Brickhill, was once a hamlet, and is now a farm. A twentieth-century census gives the population of Creslow as 5; of Ilmer, 19; of Little Hampden, 32; of Foscott, 46; of Fleet Marston, 53. Yet these were at one time thriving villages, each with a church." These and other points of historical, archaeological and architectural interest are presented by the author in a very readable manner.

Thus of the unique cottages one finds in the Chilterns, Mr. Peel describes them as being as a rule of two sorts—"those with wichert walls (found at the foot of the Hills) and those with flint walls (found on higher ground). The wichert walls are made of a local limestone and mud, which is mixed with chopped straw, and applied in layers, rather like the nest of house-martins. Many of these cottages conform to a pattern, being 22½ feet long, and having walls 15 inches thick, with one lower room 10 feet square. Nowadays such places are the homes of humble farming folk, but they were designed for, and built by, people of substance."

Among the local industries, where craftsmanship still survives, the work of the "bodger" is outstanding. Often living among the woods which supply him with his raw material, he still takes pride in the turning of beech for chairs and chair-legs, and the making of wooden rakes and wheels.

The book is illustrated with drawings by James Arnold and sixty odd excellent photographs. Some of these are of farming subjects, but it is regrettable that the author has not attempted more than a fleeting reference in his text to this most important background of the Chiltern people.

S.R.O'H.

The Face of Wales (Face of Britain Series). Tudor Edwards. Batsford. 12s. 6d.

This book is designed, as the author says, "mainly for the Sassenach who thinks of Wales only in terms of the Rhondda Valley, the playgrounds of the northern littoral, *et id genus omne*, as well as for those Anglo-Welsh condemned to live away from their Hesperides." He also hopes that Welsh people, too, will find something new and will be stimulated to further searching in their own land. The area covered is from the Island of Anglesey in the north, to the Gower Peninsula in the south, from Offa's Dyke in the east to the Irish Sea in the west—in fact, twelve counties—an apology as a "convenience, not conviction," being proffered in the preface for the omission of Monmouthshire.

The first chapter is mainly devoted to the geological formations, with notes on the "pimples and wrinkles" (mountains and valleys) which appear over this variable and formidable foundation. There are also references to the architecture, customs and some of the characteristics of the people.

Starting off from Glamorgan, including the Gower Peninsula, and then by way of Carmarthen Bay, the Vale of Towy and the Cothi Valley, the journey continues into Pembrokeshire, its islands and bays and then northwards into Cardigan to include the Teify,

Rheidol and Ystwyth Valleys. Thence we go south into Breconshire, with its Beacons and Usk Valley, and northwards again into Radnor and its forest and so to Montgomery, with its moors and mountains.

From here the journey continues westwards to Dolgelly and the Mawddach estuary, and then along the Merioneth coast into Caernarvonshire. An itinerary into Lleyn and the mountain passes of Caernarvonshire is followed by an excursion into Anglesey. The Vales of Clwyd and Llangollen are described and an exit is made over the Dee after a tour of the towns and villages of Flint.

The author obviously knows the country well, has an eye for the picturesque, and is as vivid in describing the beautiful islands and bays, the stark heights of Snowdonia, the grandeur of the hinterland, as he is eloquent in deploring the spoliation of some of the valleys of the south.

The "shonies" of the south, the mountaineering terms prevailing at Pen-y-Gwryd, the cockle-land and a school for slate quarrying form a part of the story in which historical farmhouses, *blaenau*, *hafod*, etc., are all included.

Not a castle or hall, even when in ruins, has been missed, and only a few parish churches can have escaped mention. In all cases the historical background, including many legends and the architecture, are covered with striking thoroughness.

There are over one hundred delightful illustrations which will inevitably urge the reader to delve deeper into the interest and beauty of the Principality.

W.W.

Tractors on the Farm (4th Edition). H. J. Hine. Farmer and Stock-Breeder. 7s. 6d.

No attempt is made in this book to discuss every type or make of tractor in detail ; the main aim throughout is to discuss in general terms the points that a farmer should take into consideration when selecting and using a tractor. Maintenance is dealt with in rather more detail, but here again only general principles are discussed supplemented by ample references to the existing differences between the various makes and types. This fourth edition has been enlarged to cover the more recent developments in agricultural engineering such as the use of hydraulic power and the direct attachment of implements to the tractor.

A very large field is covered by the book, and in condensing some of the arguments the author sometimes gives the impression that the solution is simpler than it is likely to be in practice. This, of course, is largely unavoidable when many of the points if discussed fully would each require a volume to themselves.

The book does, however, bring to the notice of the reader all the essential points and attempts to bring into true perspective the relative merit of each of these points. Sufficient interest is created to persuade the reader to inquire more deeply into the points discussed, and it is perhaps unfortunate that no references to further information are given.

Of particular merit, however, is the emphasis placed on maintenance ; on those jobs which the operator can and should be able to do himself and on those which are better left to skilled and experienced mechanics. Not only learners but many experienced operators and tractor owners will be able to read this book with advantage.

F.S.M.

Making Money from Cows. Kenneth Russell. The Dairy Farmer. 6s.

Any book on an agricultural subject is usually more interesting if the author can write from personal experience. Mr. K. N. Russell's book is no exception and indeed, since much of it is based on his experience of the management of two entirely different types of herd, both showing profit margins much above average, his advice must command respect.

The book will perhaps be most useful to the young dairy farmer, the progressive herdsman and the student requiring information on the practical aspects of dairy husbandry. No attempt has been made to go into details of the principles of nutrition, genetics, economics, etc., underlying modern milk production. Mr. Russell's conception of the requirements so far as day-to-day herd management is concerned, are set out briefly and in a very readable form. A few of the opinions expressed are provocative, and experimental evidence concerning them probably does not exist. For example, there are many who doubt the value of milking before calving, a method strongly advocated by Mr. Russell.

In general, however, the author has rendered a valuable service to dairy farming by bringing forward and emphasizing two features of milk production which have so often been neglected in earlier books on the subject. The first is the paramount importance of herd management. The second is the need for greater attention to the production of home-grown foods of the right quality for high milk production.

It is probably true that the major factor restricting milk output on most dairy farms is not the quality of the cattle, nor the availability of land, buildings, equipment or labour, but the efficiency with which these are integrated and used. In this respect the information given in Mr. Russell's book is very apt, since the requirements of the economist have been translated into terms of good cowmanship.

A.S.F.

East Malling Research Station. Annual Report, 1949. East Malling Research Station, Maidstone, Kent. 10s.

Like its predecessors, the new East Malling Report contributes both widely and deeply to horticultural science. The paper on the design of orchard experiments is particularly timely in view of the many new fruit trials now projected in this country. Other papers of particular concern to research workers are those describing a flame method of spectrographic analysis, procedures for plant tissue tests, and investigations of the organic constituents of apple trees.

Fruit growers will turn to the record of 15 years' comparative performance of frame-worked and of topworked apples, showing a clear superiority in the yield of the frame-worked trees. Frost damage investigations are exemplified by an illustrated paper on fruit symptoms and by a description of the effect of water sprinkling in warding off injury. Apple flowers sprinkled when the air temperature was 28°F. acquired a coating of ice that protected them from frost damage. The long-term effect of certain pruning treatments is summed up in a bulletin for fruit growers, giving the comparative results on bush apples of pruning by renewal and by spur methods.

The entomology and plant pathology sections of the Report bring up to date the records of investigations on the control of strawberry aphids, the fruit tree red spider, apple sawfly and Brown Rot. The discovery of bacterial infection of fruit spurs of sweet cherry fills one more gap in the life history of the bacterial canker organism. A progress report deals with the experiments with Rubbery Wood disease of apple trees, and general accounts are given of hop diseases and of the Scottish raspberry investigations.

The amateur grower will appreciate the article on the model fruit garden at Bradbourne. The Amos Memorial Lecture, The Soil and the Fruit Tree, forms an admirable example of a paper of equal profit to the grower and to the research worker.

The Report concludes with a frank survey of the problems of fruit marketing, the moral being that the return of competition exacts a return to high standards of market quality.

R.W.M.

A History of English Farming. C. S. Orwin. Nelson. 8s. 6d.

Food is one of the primary needs of man ; the farm is his primary means of producing it; and, throughout the ages, agriculture has absorbed a greater proportion of human thought, effort and skill than any other occupation. Thus the modern farm, to the casual eye of the urban visitor the most tranquil and stable of all industrial units, is in reality no more than the latest stage of a long development ; and this development trails back through the Agricultural Revolution, the Open Fields and the forgotten prodigies of Tudor and medieval reclamation to the prehistoric fields whose enclosures, long overgrown, still chequer so many of our chalk downlands.

Such is the story which Dr. Orwin tells in his latest book, beginning with the Iron Age and ending with the Agriculture Act of 1947 ; and he tells it with clarity and scholarship. The style is pleasant, the material both balanced and detailed, the presentation an admirable mixture of narrative and analysis. Much of the story is familiar—Dr. Orwin himself is as responsible as any man for that—but there is a particularly valuable account of the recent development and present structure of the industry which contains information not readily available elsewhere.

It may perhaps seem a little ungracious to criticize so compact a summary, yet, despite Dr. Orwin's closing words on the importance of agricultural research and education, I should have liked to see a little more space given to modern technical development. Stapledon's name, for instance, does not appear in the index, neither is E. C. Large's classic and delightful *Advance of the Fungi*, which includes history as well as mycology, mentioned in the bibliography. And, incidentally, if Davy, who introduced chemistry to the farmer, is thought worthy of a paragraph, does not Stillingfleet, his opposite number in the world of grassland, also deserve a mention ?

N.H.

Woodland Crafts in Britain. H. L. Edlin. Batsford. 15s.

From his great store of knowledge concerning wood, its ancient uses, its enduring qualities, its cultivation, the very names which cling to it from a remote ancestry, Mr. Edlin has given us a book of great value and interest. Not only is it a timely record of much of the ancient lore of the woodlands—some of it lately confirmed by modern science—but also it gives a clear appreciation of the present value of our woodland heritage and points a finger to those traditional crafts such as cleaving and basket-making which still offer a future to suitable young people.

The mechanized processes of the modern timber trade are outside the scope of this book, but Mr. Edlin makes it clear that mechanical development, although restricting the field of the craftsman, does not extinguish him. No doubt the machine will supply the general run of products, but when articles of superior excellence or individual character

are needed, the craftsman comes into his own. It would be difficult to imagine a generation that had no use for a wattle hurdle, a cleft axe-handle, a wicker basket or an individual piece of hand-made furniture. No machine can produce the superior strength of the cleft article nor can yet conveniently make a basket.

This exhaustive account of the British woodlands and the multitude of needs which they have met in the past stimulates speculation upon their modern application. As Mr. Edlin points out, the introduction of wire paling at the beginning of the century led to the development of a thriving cleft chestnut fencing industry that continues to employ hundreds of craftsmen. When the whirligig of modern economics has recovered its equilibrium we may be grateful to those owners and craftsmen who have not forsaken the ancient woodlands that still stretch in silent billows across the land.

Whether you are a farmer interested in the possible uses to which a few acres of woodland can be put, a housewife seeking a recipe for maple syrup, or a pioneer wondering how best to make a log cabin, this book provides the answer to these and many other questions related directly or indirectly to the woodlands. Moreover this impressive display of knowledge is well and vividly written and presented with that standard of book production which we have learnt to expect from the publishers.

J.N.W.

The Moult Migration of the Sheld-Duck. ROBERT A. H. COOMBES. International Wildfowl Research Institute. 2s.

This report by Mr. Robert Coombes, of the new International Wildfowl Research Institute at Tring, has been reprinted from *Ibis* and issued by the Institute as a separate publication at 2s. post free.

The report describes one of the most interesting and valuable pieces of wildfowl investigation yet published, for the author has brought to light many new facts that make fascinating reading for the bird-lover and provide useful new information for the scientist. He has established that Sheld-ducks migrate neither in spring nor in autumn but shortly after midsummer, that the exodus in July consists of the entire non-breeding population of Sheld-ducks and almost the entire population of adult breeding birds. The young birds of the year, most of them tiny and still in down, thus deserted by their parents are joined in large groups, each group under the care of one or two adult " nursemaids " left behind for the purpose. As to this, the inquiring layman will inevitably be tempted to ask the only questions to which, apparently, Mr. Coombes has not provided answers—how are these nursemaids chosen and how are they induced to undertake the role ?

Further interesting facts established by Mr. Coombes are that, although the Sheld-duck is essentially a marine duck, the migrating birds do not follow the coast but travel overland across Great Britain before taking wing to their destination on the Continent ; that the same points of departure are adhered to each year ; that certain weather conditions are necessary to the migration, and that the trans-England stage of the migration takes place at a definite time of day.

In view of the prevailing anxiety about the status of certain of our wildfowl, such observations as these are not only extremely valuable but are a happy augury for the future work of the Institute under the direction of Mr. Coombes.

F.H.L.

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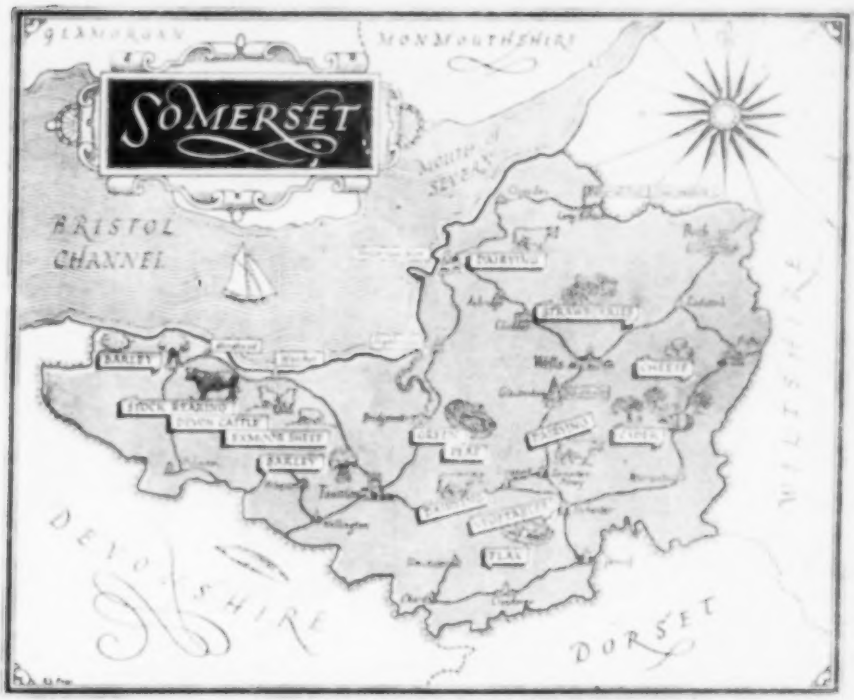
FARMING THROUGHOUT THE WORLD

Switzerland exports large quantities of chocolate and tinned milk, extensive herds of cattle being maintained on the lower slopes of the Alps.

Besides giving tourists many delightful views, the mountain country provides the cattle with excellent pasturage.

Lessons from the Counties



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There is a magic in the very name of Somerset that conjures up thoughts of apple blossom, long draughts of cider, and snug farms where time stands still.

These illusions derive from the stories and songs of this V-shaped county, whose single foot rests near the south coast where Devon and Dorset join, while the northern arms bear the harsher uplands of Mendip and Exmoor.

To-day, Somerset is building a new tradition around its capacity to grow grass, but this time there is no illusion. Grass grows early, grass grows late, and in summer there is enough to provide ample grazing, and a generous surplus to be cut for winter, preserved as silage or artificially dried. This grass is healthy, too, for the old curse of the "Teart" pastures has yielded to the benison of science.

This growing of grass—Somerset's greatest crop—has not come about haphazardly. The method and techniques now being adopted are far removed from those of local tradition. Better management and the increasing use of phosphates, potash and lime will enable more stock to be carried than ever before, and for the additional grass required the vital factor is nitrogen.